STATE OF ARKANSAS

ARKANSAS GEOLOGICAL SURVEY
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NATURAL GAS POTENTIAL OF PENNSYLVANIAN TIGHT SANDSTONE RESERVOIRS—FRONTAL OUACHITA FOLD AND THRUST BELT, WEST-CENTRAL ARKANSAS

by

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Acknowledgments

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We would also like to thank the following staff of the Arkansas Geological Survey. We are most appreciative for the assistance of Susan Young and Nathan Taylor in preparing the plates for this publication. We also thank Jack Stephenson for assisting with the sampling of core and well cuttings at the Norman F. Williams Well Log Library in Little Rock. Finally, we would like to thank the geologic staff at the Arkansas Geological Survey for reviewing the technical aspects of this report.

Terminology of Major Structural Belts and the Fairway Region

There are several gas producing regions and structural belts within the Arkoma basin of Arkansas and these geologic terms are widely used by oil and gas operators, consultants, and academics who conduct geologic research in the west-central portion of Arkansas. A general description of the structural belts from south to north are summarized below and the reader is referred to the work of Arbentz (1989) for a more detailed discussion of the structural elements of the region.

The entire Ouachita Mountains region south of the “Y” City Fault is commonly referred to as the “central Ouachita thrust belt” (Figure 1). This belt contains three segments including an exhumed core of tightly folded and thrusted lower Paleozoic rocks referred to as the Benton Uplift (Miser, 1959; Lillie *et al*., 1983). The structural style, deformational history, and thermal evolution of the Benton Uplift are unique and different from the rest of the central thrust belt. The region shown in Figure 1 between the Choctaw and Ross Creek faults and the "Y" City fault is referred to as "frontal Ouachita thrust belt" and consists of one giant faulted syncline in the massive lower and middle Atoka. North of Waldron, Arkansas, the Choctaw fault disappears in the core of the Hon anticline which plunges northward. A few miles south of Waldron, the Ross Creek fault takes over the role of the mountain front and continues eastward toward the Mississippi Embayment. Surface attitudes of the thrust sheets in the frontal imbricated zone are generally quite steep (45°- 65°) and local refolding of the faults can be observed in plunge projection. Some klippen are recognizable by juxtaposition of out-of-place facies and apparent younger-over-older thrust configurations.

The belt of rocks that lies immediately north of the frontal belt and to the south of the fairway region is referred to in this paper as the "transition zone" and represents a mildly compressed thin-skin fold belt detached along lower Atokan shales (Figure 1). Compressional structures in the transition zone diminish northward as the fairway region is approached. Many of the shallow thrust faults of the transition zone terminate in the subsurface against south-dipping down-to-basin growth faults. Large open folds such as the Backbone Anticline south of Greenwood, Arkansas represent the northern extent of large-scale folding in the transition zone.

The "fairway region" is defined in this paper as the conventional gas fields located north of the transition zone and consists of Atokan siliclastics with interbedded

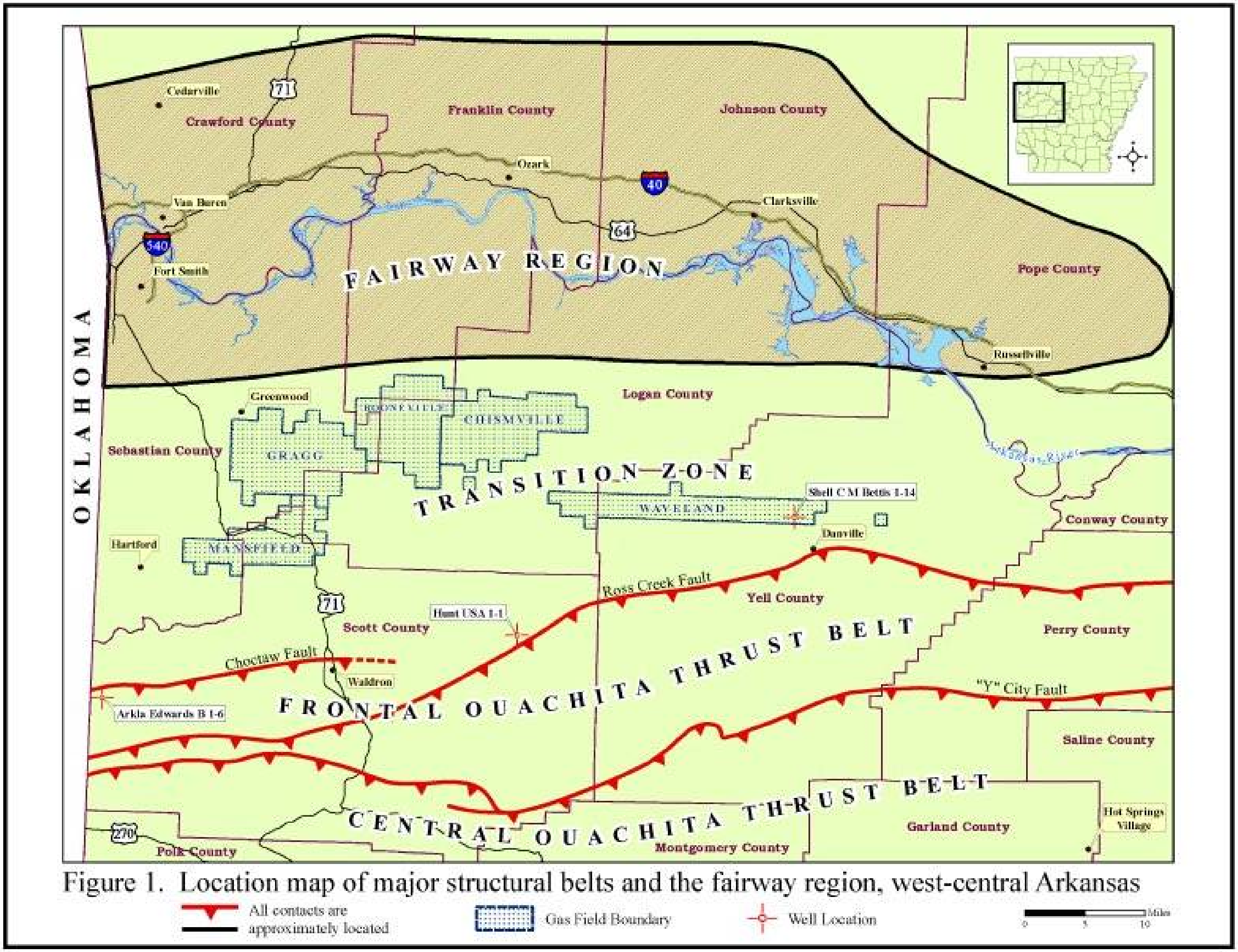

Figure 1. Location map of major structural belts and the fairway region, west-central Arkansas

Figure 1. Location map of proposed structural belts and gas producing regions – Arkoma basin, Arkansas.

shales that were deposited in a continental shelf environment. Although compressional structures are less prevalent in this region, normal faults are quite common and consist of steeply-dipping to listric growth faults that had a profound effect on the syndepositional accumulation of thick sandstone sequences. Historically, the fairway region has produced the majority of natural gas within the Arkoma basin of Arkansas and these stratigraphic sequences tend to have a higher degree of permeability and porosity.

Introduction

This project is a joint research effort to examine the gas reservoir characteristics of “tight sandstone” in this region of Arkansas. The project is a collaborative effort between the Arkansas Geological Survey and Southwestern Energy & Production Company of Houston, Texas. The principal objectives of the project are to characterize the reservoir properties of Pennsylvanian sandstones from three wells located in the study area (Figure 1) and compare them with those of conventional sandstone reservoirs in the fairway region located to the north. The clastic stratigraphic sequences that were studied are typical of “tight sandstone” reservoirs (Chen and Robbins, 1991; Brown and Woodward, 1993) and thus inherently possess low porosity and low permeability characteristics necessitating well stimulation procedures for gas production.

Methodology

Well cuttings were sampled from the Arkla, Edwards “B” No. 1-6 and the Hunt, USA No. 1-1. Core plugs were extracted from the Shell, C.M. Bettis No. 1-14. All three wells are located in Scott and Yell Counties, west-central Arkansas (Figure 1). The primary data compiled include well logs, photomicrographs, petrographic descriptions of thin sections, porosity and permeability data from core, and vitrinite reflectance measurements from interbedded shale samples. The pertinent data is compiled and presented in Plates 1-3 for each well and additional data is presented in Appendices 1-4. It is noted that porosity and permeability analysis was conducted only for the C.M. Bettis No. 1-14 well and thin section descriptions are not available for the Edwards “B” No. 1-6 well. Well logs, including Gamma Ray (GR), Spontaneous Potential (SP) and Resistivity (R), were acquired from the El Dorado office of the Arkansas Oil and Gas Commission. Well cuttings and core plugs were sampled at the Norman F. Williams Well Log Library in Little Rock, Arkansas. Core analyses were conducted by Omni Laboratories Inc. of Houston, Texas. Organic geochemistry and vitrinite reflectance analyses of shale-rich well cuttings for the Edwards “B” No. 1-6, and Hunt USA No. 1-1 wells were conducted by Geotrack Inc. of Australia. These latter studies facilitate an understanding of kerogen type, organic richness, and a thermal maturation profile associated with the depositional and compressional tectonic history of the region.

Porosity and Permeability Analysis

Porosity and permeability data for Pennsylvanian sandstones in the fairway region of the Arkoma basin have been collected and reviewed. Most of the data that is observed is from the Atoka Formation, with lesser amounts of data derived from Morrowan age rocks. The Atoka Formation is informally divided into lower, middle, and upper members on the basis of three distinct geologic environments that reflect Atoka deposition in the Arkoma basin (Houseknecht, 1986).

The lower Atoka distributary channel facies consists of sands that were deposited on a relatively stable shelf (Johnson *et al*., 1989). The lower Atoka sequence consists of fine to very fine-grained sandstones and produce natural gas at depths from 2,755 to 12,000 ft. with net pay ranging from 15 to 55 ft. Porosity ranges from 8 to 17.5% and permeability ranges from 0.13 to 24 millidarcies (md) in the Arkansas portion of the Arkoma basin (Figures 2 to 4).

Throughout the Arkoma basin, the middle Atoka sequence consists of submarine fans and channels that are characterized by deepening water deposition during a time of syndepositional extensional faulting (Johnson *et al*., 1989). The middle Atoka sandstones produce natural gas from 2,237 to 8,000 ft. (Brown and Woodward, 1993). Porosity values range from 5.9 to 13.19% and permeability ranges from 0.04 to 8 md (Figures 2 to 4).

The upper Atoka transgressive sandstones are characterized by deposition in shallow to moderately deep water. Upper Atoka sandstone reservoirs range in depth from 1,958 to 5,120 ft. Porosity varies from 5 to 15%, and permeability ranges from 0.12 to 12.9 md (Figures 2 to 4). Morrowan sandstones and limestones are deposited in shallow marine environments. Producing reservoirs are developed at depths of 5,300 to 8,100 ft. with a reported porosity range of 7 to 14% and permeability range of 0.2 to 42 md (Chen and Robbins, 1991; Figures 2 to 4).

Core plug samples from the C.M. Bettis No. 1-14 well were collected on site by technicians from Omni Laboratories and were analyzed for porosity and permeability determinations. Core samples were derived from depths ranging from 9,280.8 ft. to 11,073.45 ft. and are composed essentially of very fine to fine-grained sandstones. The

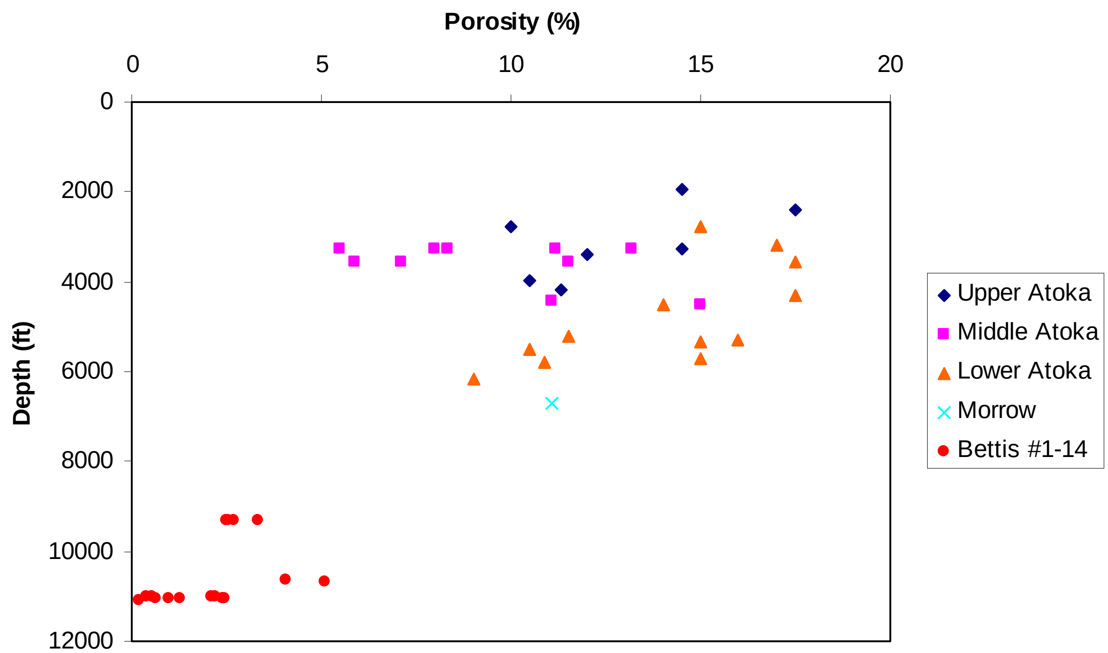

Figure 2. Comparison of porosity data between sandstones in the fairway region and tight sandstones in the Shell, C.M. Bettis No. 1-14 well.

tight sandstones are characterized by low porosity (0.2% - 5.1%; 2.1% on average) and extremely low permeability values (0.0002 to 0.0035 md; 0.0012 md on average) as shown on Figure 5. These values are indicative of a higher degree of mechanical and chemical compaction, quartz overgrowth, dissolution of soluble materials, and increased quartz and clay ingrowths compared to conventional sandstone reservoirs in the fairway region.

Vitrinite Reflectance Analysis

Eleven (11) shale-rich samples were collected from well cuttings associated with the Edwards "B" No. 1-6 well and eleven (11) shale-rich samples were collected from well cuttings associated with the USA No. 1-1 well. Samples from both wells were submitted to Geotrack Inc. of Australia for vitrinite reflectance (Ro) analysis to assess the

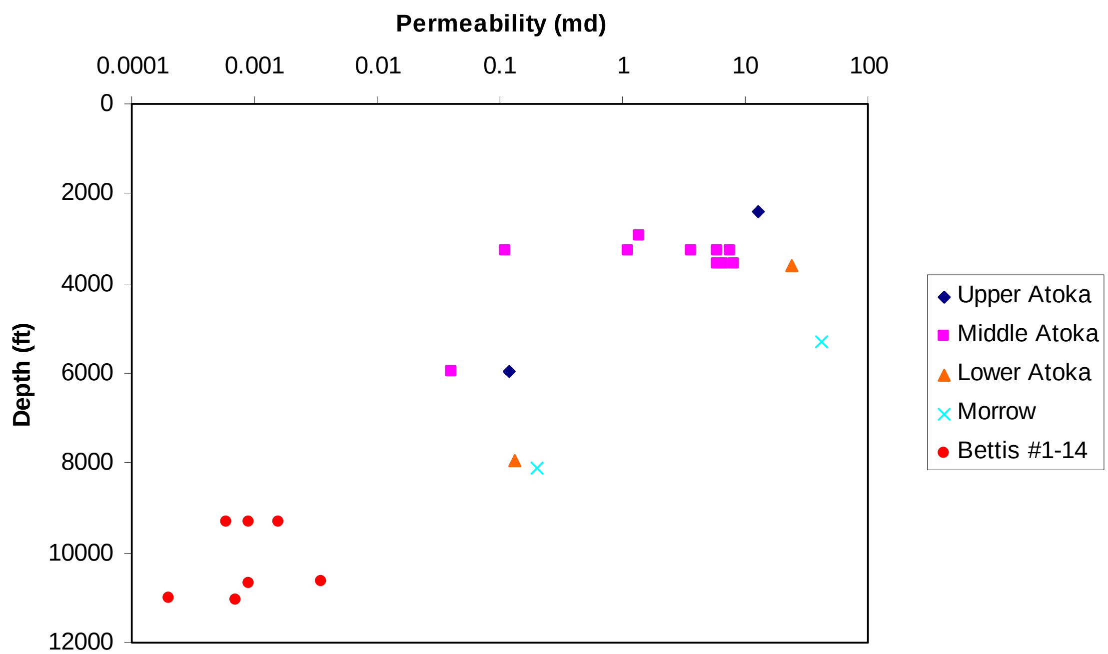

Figure 3. Comparison of permeability data between the sandstones in the fairway region and the tight sandstones in Shell, C.M. Bettis No. 1-14 well.

thermal maturation characteristics of interbedded sandstone reservoirs. Ro values from both wells are very high and range from about Ro = 5.6 to 6.7% (Appendix 3). Gross *et al.* (1995) reported that Ro values range from 2.17 to 3.23% in the C.M. Bettis No. 1-14 well. It is the opinion of the authors that these high levels of thermal maturity within and along the frontal Ouachita belt are due to a combination of orogenic fluids, igneous activity, and isostatic rebound of deeply buried rocks following cessation of tectonics.

These Ro values are typically beyond the limit for preservation of “conventional” dry gas,

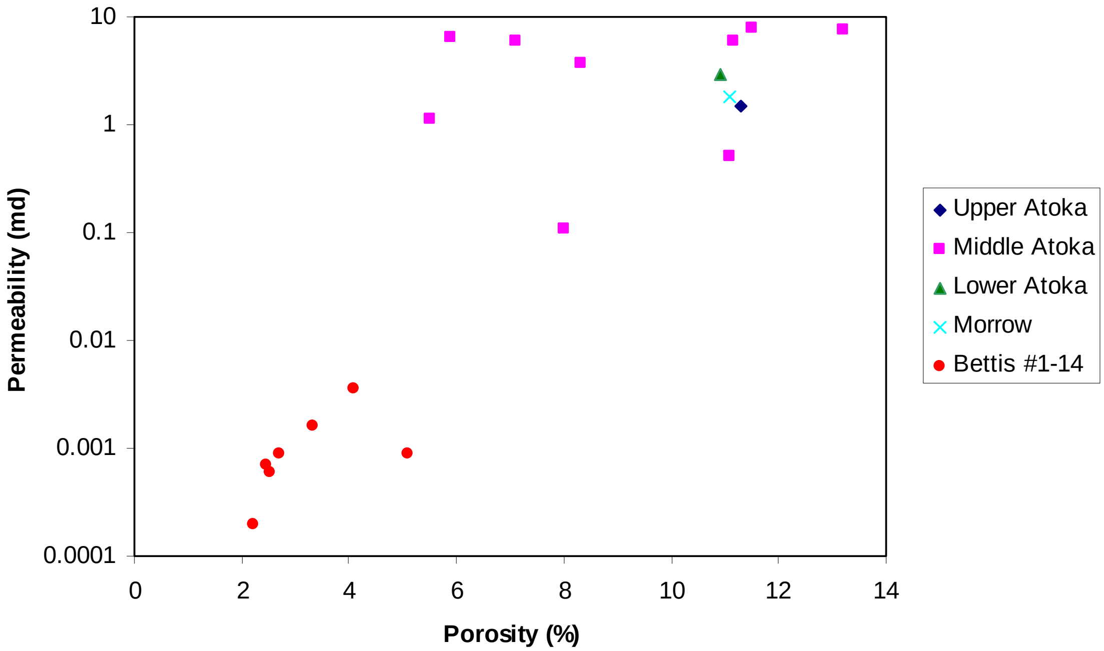

Figure 4. Comparison of permeability and porosity data between the sandstones in the fairway region and the tight sandstones in Shell, C.M. Bettis No. 1-14 well.

which seems to suggest that the methane preservation deadline in the foreland basin and frontal thrust belt can be considerably greater than the presently accepted preservation limit of 4.8 % Ro. For more vitrinite reflectance information on these two wells, please refer to Appendix 3.

Well Logs - Photomicrographs and Thin Section Descriptions

Subsurface well logs of the three wells, which include Gamma Ray (GR), Spontaneous Potential (SP), and Resistivity (R), were acquired for the corresponding intervals that are analyzed for geochemistry, petrography, and core analysis. The geophysical log intervals for the sampled ranges are shown on the left side of Plates 1-3 with corresponding photomicrographs, thin section descriptions, vitrinite reflectance values, and core data information. In the study area, conventional well log analysis is

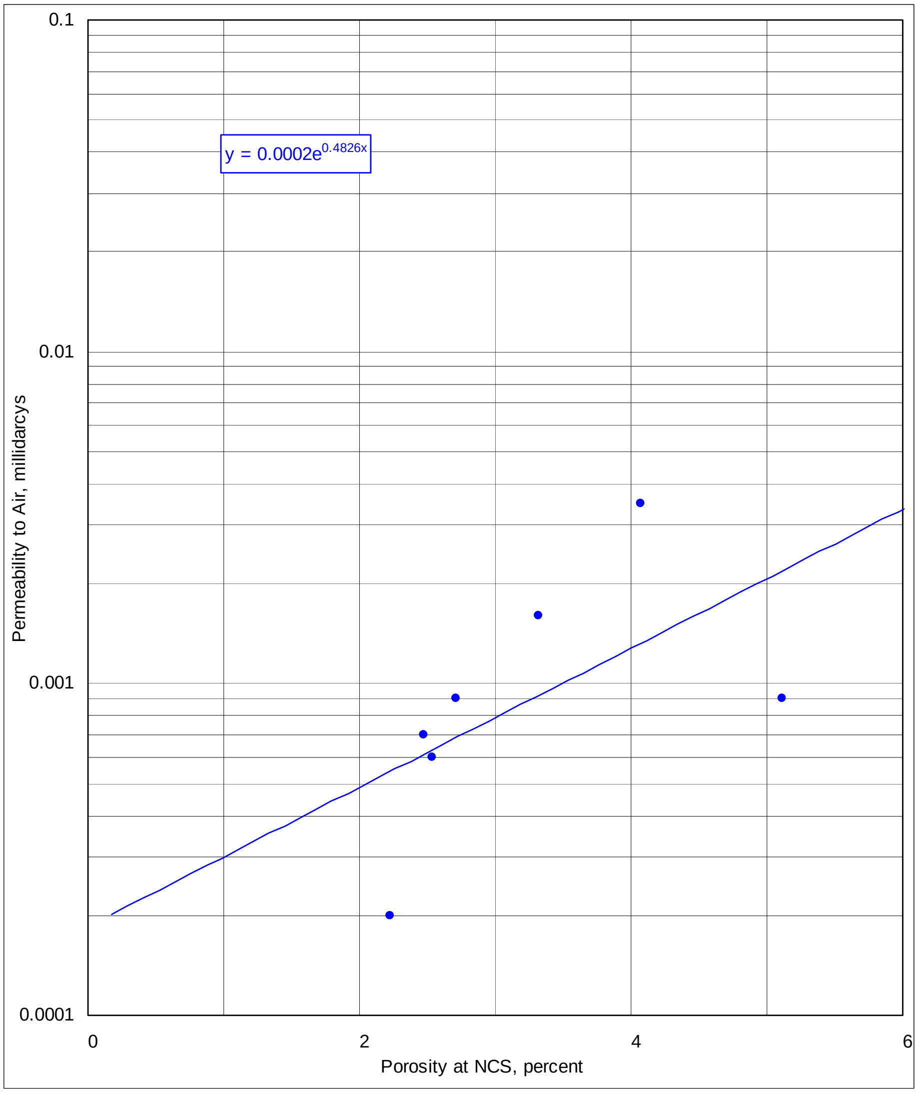

Figure 5. Permeability vs. porosity plot for Shell, C.M. Bettis No. 1-14.

very difficult due to telescoped and thrust duplexes of stratigraphic units associated with the Ouachita orogeny. John Allison of XTO Energy has considerable experience with gas exploration in this region of Arkansas and provided the stratigraphic top and fault picks that are marked on the well log portions of Plates 1-3.

Discussion

The three wells studied along the frontal Ouachita thrust belt show considerably higher levels of thermal maturity compared to those in the fairway region and the central portion of the eastern Arkoma basin adjacent to the Mississippi Embayment (Houseknecht *et al.,* 1992; Ratchford *et al*., 2006). The authors believe that the primary geologic factor in the elevated vitrinite values for the three wells is due to their close proximity to the core region of compressional deformation associated with the Benton Uplift in the Ouachita Mountain region. Heated orogenic fluids expelled during the Ouachita Orogeny would likely exert more influence on the thermal maturation process in this region than other contributing geologic factors. Local stratigraphic facies with higher permeability and porosity values were more susceptible to migrating orogenic fluids and hence higher thermal maturities.

However, other contributing geologic factors such as local igneous activity and deep burial of stratigraphic sequences have also had a profound influence on the thermal maturation history in the Arkoma basin. The reader is also referred to the work of Byrnes *et al.* (1999), who modeled the burial and maturation history and petroleum generation timing of Arkoma basin rocks in Arkansas and Oklahoma. Byrnes *et al.* (1999) suggested that 5,000 to 15,000 ft. of stratigraphic section has been removed from the Arkoma basin region, and as much as 25,000 to 40,000 ft. has been removed from areas of the Ouachita fold belt.

All of the three wells that are studied in this project were drilled from 1964 to 1982 and are reported as dry holes by the Arkansas Oil and Gas Commission. However, productive gas wells are present within the transition zone and the more recently developed Waveland gas field lies north, but proximal to the frontal Ouachita thrust belt (Figure 1). Appendix 4 lists three (3) representative gas wells located within the Waveland gas field to illustrate that gas production is feasible as exploration for structurally complex reservoirs continues southward toward the frontal belt. The technical advance of well stimulation and completion technologies greatly facilitates the success in producing natural gas from tight sandstone reservoirs.

Low porosity and permeability characteristics coupled with increased drilling depths and structural anisotropy within and along the frontal Ouachita thrust belt will likely result in higher exploration and development costs compared to the fairway region located further north. Hydraulic and chemical stimulation procedures are likely needed to enhance gas production from the fine-grained “tight sandstone” reservoirs along the frontal belt.

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Petrography, Core Analysis, and Vitrinite Reflectance Measurements, Shell C.M. Bettis No. 1-14 Well, Yell County, Arkansas

PLATE 1

By Ed Ratchford and Peng Li

Arkansas Geological Survey

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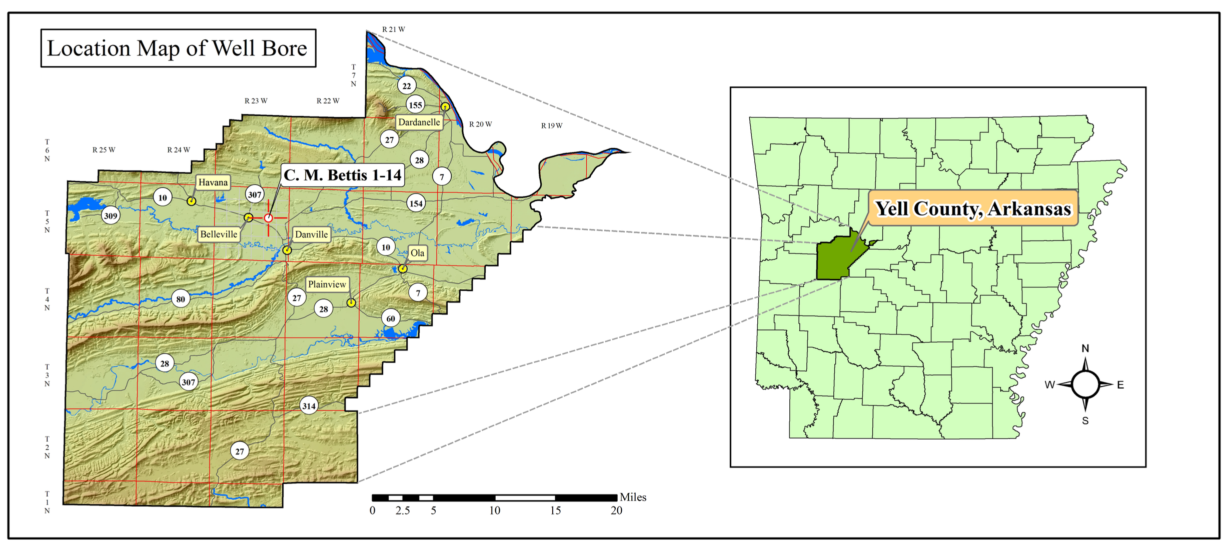
Plate 1 of 3

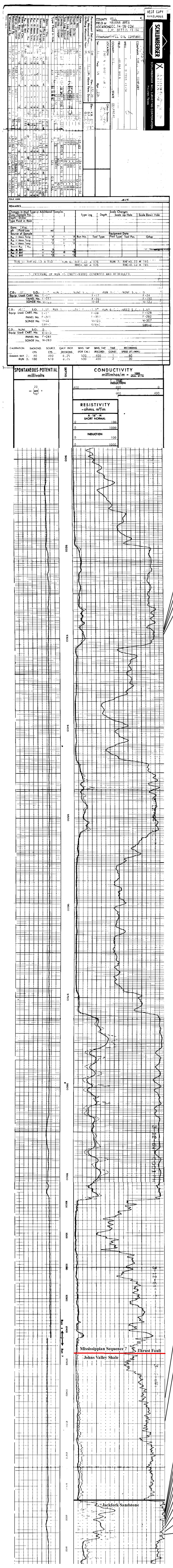
On the accompanying disk a manuscript file supplements Plate 1 as a separate Microsoft Word® document: Arkansas Geological Survey Information Circular 38

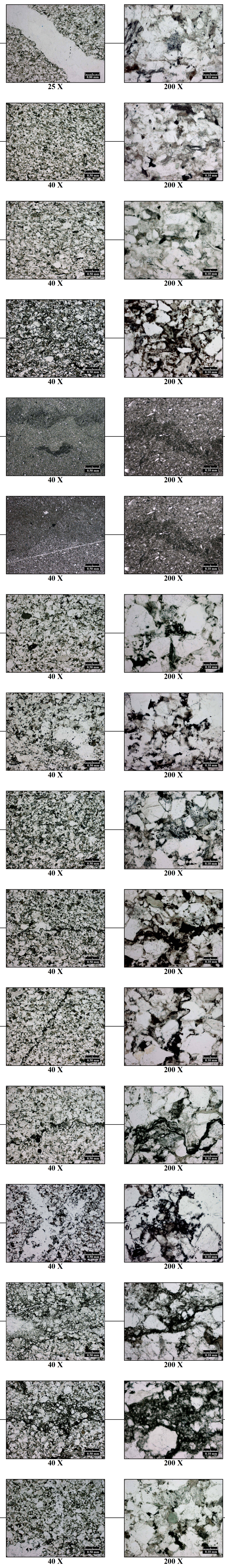


Vitrinite Reflectance Measurements - Shell C.M. Bettis No. 1-14 Well

Depth (ft)	Ro (%)
1,315	2.19
1,735	2.17
2,165	2.4
2,665	2.36
3,165	2.4
3,475	2.29
3,815	2.44
4,135	2.62
4,665	2.69
5,215	2.6
5,645	2.74
6,035	2.77
10,637	2.95
11,012	3.23
11,067	3.16

Data From: Gross et. al, 1995





Depth (ft)	Lithology/Texture	Pore System	Fractures (Cement Fill)	Klink. Perm. (md)	Porosity (800 psi) (%)	Grain Density (gm/cc)
9,290.80	**Fine-grained sandstone;** faintly bedded due to subtle differences in grain size; moderately sorted; highly compacted, common deformed ductile grains; common authigenic clay (including chlorite) coats grains and fills remnant intergranular areas; irregularly developed quartz overgrowths generally occur as discontinuous rims that vary in thickness; titanium oxide is present as a grain alteration and as cement; solid hydrocarbon locally fills intercrystalline pores in authigenic clays and altered grains.	Micropores occur within altered grains (particularly mica) and authigenic clays; trace intercrystalline pores between authigenic quartz cement crystals within fractures.	Three (3) authigenic quartz-filled fractures oriented at oblique angles to bedding; two (2) fractures have the same approximate orientation; the remaining fracture is oriented approximately perpendicular to the other fractures.	<0.0001	2.5	2.69
9,291.85	**Very fine-grained sandstone;** bedded; moderately well sorted; highly compacted, abundant deformed ductile grains; common authigenic clay (including chlorite) forms coatings on grains and fills intergranular pores; erratically developed quartz overgrowths occur as discontinuous rims of varying thickness; fill intergranular areas; very fine to fine crystalline titanium oxide occurs as grain alteration and intergranular cement; trace siderite grain replacement; minor solid hydrocarbon in authigenic clays and altered grains.	A network of micropores occur within argillaceous and/or altered grains (particularly mica) and between crystal of authigenic clay.		0.0003	3.3	2.71
9,294.10	**Very fine-grained sandstone;** bedded; moderately sorted; highly compacted, abundant deformed ductile grains; common authigenic clay (including chlorite) forms coatings on grains and fills intergranular pores; erratically developed quartz overgrowths form partial rims of variable thickness; minor titanium oxide as grain alteration and intergranular cement; trace replacement pyrite.	A network of micropores occur within argillaceous and/or altered grains (particularly mica) and between crystal of authigenic clay.		0.0001	2.7	2.70
9,297.50	**Sideritic, very fine-grained sandstone;** localized faint traces of bedding; highly compacted; common deformed ductile grains; abundant fine crystalline siderite occurs as an intergranular cement, often forming thin coatings on grains, and also present as a pore-filling cement and grain replacement; quartz overgrowths are erratically developed, occurring as discontinuous rims that are of variable thickness; minor to trace amounts of pyrite replacement and titanium oxide that occurs as grain alteration or intergranular cement.	Micropores occur within argillaceous and/or altered grains (particularly mica); a minor amount of microporosity is associated with authigenic clays.		0.0001	2.5	2.74
10,637.05	**Sideritic, argillaceous siltstone;** disturbed; appears soft-sediment deformed and/or burrowed; common mica, but most appears altered; scattered small carbonaceous fragments; a few widely scattered agglutinated foraminifera and small phosphate- and siderite-replaced clasts; irregular areas with common fine crystalline siderite replacement; common finely disseminated replacement pyrite.	Micropores are present within very small grains (argillaceous?, mica) and organic fragments; micropores are barely visible within the argillaceous matrix.	A fracture occurs along a margin of the sample that is oriented parallel or at a very low-angle relative to bedding and is filled with a combination of dolomite, authigenic quartz, and authigenic clay(?).	0.0009	4.1	2.81
10,659.00	**Sideritic, argillaceous siltstone;** bedding appears disturbed by burrowing and possibly soft-sediment deformation; relatively coarser grained, grain-rich lamination; common mica most of which appears altered; rare agglutinated foraminifera; scattered small carbonaceous fragments; common erratically distributed fine crystalline siderite replacement; minor amount of finely disseminated replacement pyrite.	Micropores are present within very small grains (argillaceous?, mica) and organic fragments; micropores are barely visible within the argillaceous matrix.		0.0002	5.1	2.80
11,000.15	**Fine-grained sandstone;** faintly bedded; moderately sorted; highly compacted, common deformed ductile grains; intergranular areas are filled mostly by quartz overgrowths, with less common authigenic clay cement (including chlorite); titanium oxide occurs as a grain alteration and as intergranular cement; authigenic clays appear lightly stained with solid hydrocarbon.	Micropores occur within argillaceous and/or altered grains (particularly mica), and are also present between crystals of authigenic clays.		<0.0001	0.4	2.68
11,007.85	**Fine-grained sandstone;** bedded; locally disturbed by burrows or soft-sediment deformation(?); highly compacted, common deformed ductile grains; a few discontinuous microstylolites; intergranular areas are dominantly filled by erratically developed quartz overgrowth cement and common authigenic clay cement; solid hydrocarbon also fills intergranular pores and micropores associated with authigenic clays and altered grains; minor authigenic titanium oxide.	Micropores occur within argillaceous and/or altered grains (particularly mica); a minor amount of microporosity is associated with authigenic clays.	Several non-planar fractures that are oriented at oblique- to high-angles relative to bedding; filled with authigenic quartz and solid hydrocarbon.	<0.0001	0.5	2.68
11,016.30	**Fine-grained sandstone;** localized faint traces of bedding; highly compacted, moderately sorted; common ductile grains; common irregularly distributed quartz overgrowth cement and authigenic clay cement (including chlorite) fill intergranular areas; minor authigenic titanium oxide as grain alteration and cement; solid hydrocarbon fills micropores associated with authigenic clays and altered grains.	Dominantly micropores that occur within argillaceous and/or altered grains (largely ductile grains); a smaller amount of micropores is associated with authigenic clays.		<0.0001	2.2	2.69
11,025.40	**Fine-grained sandstone;** bedding locally discernible, including a slightly undulose bed contact marked by a fairly distinct change in grain size; moderately sorted; a few organic-lined microstylolites; highly compacted, common deformed ductile grains; intergranular areas are filled mostly by quartz overgrowths and authigenic clay cements, with solid hydrocarbon also present in micropores; authigenic titanium oxide is scattered throughout the sample as a grain alteration and intergranular cement.	Micropores occur within argillaceous and/or altered grains (particularly mica), and are also present between crystals of authigenic clays.		<0.0001	2.1	2.68
11,033.75	**Fine-grained sandstone;** bedding defined by differences in grain sizes; an organic-lined microstylolite at moderately high-angle relative to bedding; moderately sorted; highly compacted with common deformed ductile grains; quartz overgrowths are the dominant cement, occurring as irregular rims on quartz grains; authigenic clay (including chlorite) occurs as thin, partial grain coatings; intercrystalline micropores associated with authigenic clays and micropores in altered grains are filled/lined with solid hydrocarbon; trace replacement pyrite.	A network of micropores occurs within argillaceous and/or altered grains (particularly mica) and between crystal of authigenic clay.		0.0001	2.5	2.68
11,040.50	**Fine-grained sandstone;** faintly bedded; moderately sorted; highly compacted, common deformed ductile grains; organic-lined microstylolite subparallel to bedding; intergranular areas are dominantly filled with quartz overgrowth cement, with a subordinate quantity of authigenic clay cement; solid hydrocarbon fills micropores associated with authigenic clays and altered grains; authigenic titanium oxide is dominantly a grain alteration and also an intergranular cement; trace replacement pyrite.	A network of micropores occur within argillaceous and/or altered grains (particularly mica) and between crystal of authigenic clay.	A authigenic quartz-filled fracture is oriented at a low-angle relative to bedding.	<0.0001	2.4	2.68
11,048.40	**Fine-grained sandstone;** bedded; bedding disturbed by possible small-scale faults and fractures; moderately to poorly sorted; highly compacted, common deformed ductile grains; microstylolites appear to have formed along faults; dominantly quartz cemented with lesser authigenic clay cement (including authigenic chlorite); solid hydrocarbon fills micropore associated with authigenic clays and altered grains; minor titanium oxide as a grain alteration and intergranular cement.	Dominantly micropores that occur within argillaceous and/or altered grains (largely ductile grains); a smaller amount of micropores is associated with authigenic clays.	A few apparently discontinuous, quartz cement-filled fractures that are possibly related to the small-scale faults and/or microstylolites; apparent aperture widths of fractures decrease away from faults.	<0.0001	1.3	2.68
11,056.35	**Slightly argillaceous, fine-grained sandstone;** appears brecciated with argillaceous sandstone fill around breccia clasts; host brecciated sandstone is bedded and lacks depositional matrix; highly compacted, common deformed ductile grains; several discontinuous microstylolites; clean sand dominantly cemented by quartz overgrowths; quartz cement also fills an irregular fracture; authigenic clay (including authigenic chlorite) forms thin grain coatings and also fills pores; detrital clay matrix appears to fill intergranular areas in sediment fill around breccia clasts; solid hydrocarbon fills micropores associated with authigenic and detrital clays, and also occurs in intercrystalline areas between quartz cement crystals; minor authigenic titanium oxide as a grain alteration.	Dominantly micropores that occur within argillaceous and/or altered grains (largely ductile grains); a smaller amount of micropores is associated with authigenic clays or occurs within the argillaceous matrix.	A few authigenic quartz-filled fractures are oriented at oblique angles relative to bedding; apparent aperture widths are highly variable.	<0.0001	1.0	2.68
11,067.30	**Fine-grained sandstone;** faint bedding visible in portions of the sample; microstylolite with concentrations of organic matter and clay(?); highly compacted, common deformed ductile grains; intergranular areas are filled with a combination of quartz overgrowth cement and authigenic clay (including chlorite); solid hydrocarbon occurs in intercrystalline areas of authigenic clays and in altered grains; possible skeletal mold filled with authigenic quartz cement; minor authigenic titanium oxide.	A network of micropores occur within argillaceous and/or altered grains (particularly mica) and between crystal of authigenic clay.		<0.0001	0.6	2.69
11,073.45	**Very fine- to fine-grained sandstone;** faint, poorly defined bedding; moderately sorted; highly compacted, common deformed ductile grains; a few scattered carbonaceous fragments; intergranular areas are dominantly filled with a combination of quartz overgrowth cement and authigenic clay (including chlorite); minor authigenic titanium oxide as grain alteration and cement; trace replacement pyrite; solid hydrocarbon fills micropores associated with authigenic clays and altered grains.	A network of micropores occur within argillaceous and/or altered grains (particularly mica) and between crystal of authigenic clay.	Discontinuous, non-planar fracture filled with authigenic quartz cement and minor solid hydrocarbon.	<0.0001	0.2	2.68

Petrography and Vitrinite Reflectance Measurements, Hunt USA 1-1 Well, Scott County, Arkansas

PLATE 2

By Ed Ratchford and Peng Li

Arkansas Geological Survey

Bekki White, Director and State Geologist
Digital Compilation by Nathan Taylor
2008

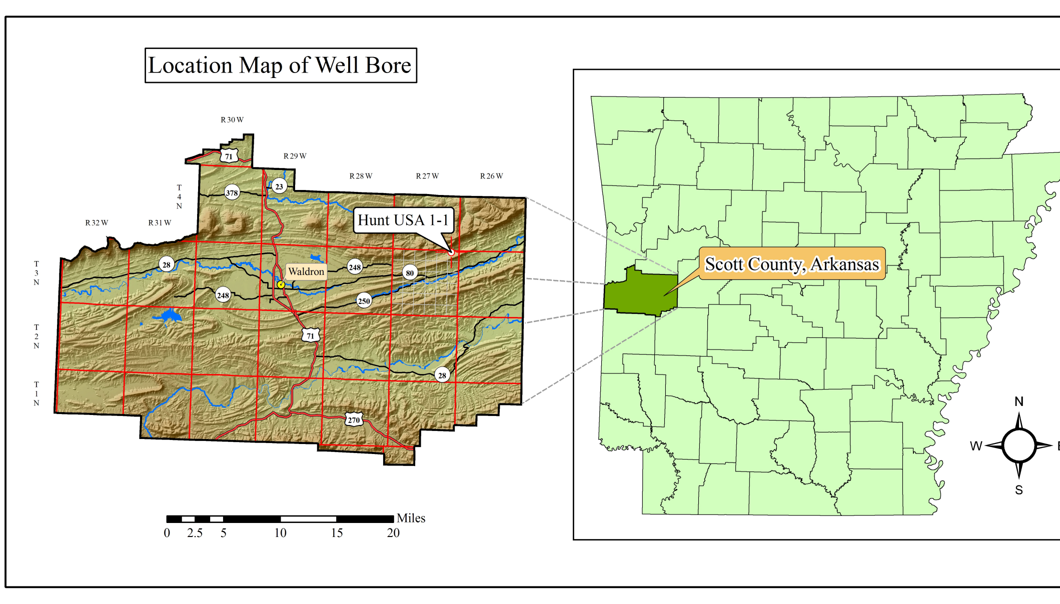
Plate 2 of 3

On the accompanying disk a manuscript file supplements Plate 2 as a separate Microsoft Word® document: Arkansas Geological Survey Information Circular 38

Vitrinite Reflectance Measurements - Hunt USA 1-1 Well

Depth (ft)	Ro (%)
11,400-11,450	5.69
11,900-11,920	5.84
12,450-12,500	6.04
12,850-12,900	6.08
13,660-13,700	6.18
14,140-14,170	6.23
14,610-14,630	6.19
15,050-15,110	6.35
15,600-15,650	6.28
16,270-16,300	6.43
16,630-16,670	6.5

Data from Geotrack Report # 967 in Appendix



10,990-11,000 ft

[illegible]

11,640-11,650 ft

[illegible]

11,860-11,870 ft

[illegible]

11,990-12,000 ft

[illegible]

12,610-12,620 ft

[illegible]

12,650-12,660 ft

[illegible]

12,720-12,730 ft

[illegible]

12,900-12,910 ft

[illegible] trace to minor quantities of ferroan dolomite replacement, titanium oxide as grain alteration/cement, and replacement pyrite; no pores visible using standard petrographic techniques.

Much smaller amount of argillaceous siltstone and organic-rich, silty shale to argillaceous siltstone; trace clean, very fine-grained sandstone; no visible pores.

12,950-12,960 ft

Fine-grained sandstone; several cuttings are slightly sideritic to sideritic; a few cuttings contain crude, poorly defined bedding; moderately well to moderately sorted; highly compacted, common deformed ductile grains; possible calcareous skeletal grain and an apparent chert-replaced echinoderm; intergranular areas are dominantly cemented by quartz overgrowths and authigenic clay; authigenic clay has formed discontinuous grain coatings and fills intergranular pores; variably developed fine crystalline siderite has formed as a grain coating, and appears intermixed with authigenic clay; scattered crystals of ferroan dolomite that occurs as grain replacement and cement; minor titanium oxide as grain alteration/cement; trace replacement pyrite; micropores are often visible within accumulations of authigenic clay cement; rare small intergranular and secondary intragranular/grain moldic pores.

Epifluorescence petrography reveals micropores are well developed within the intergranular authigenic clays of sandstone cuttings, apparently forming a network of micropores; micropores are also present in compacted argillaceous grains and altered grains.

Minor to trace quantities of argillaceous siltstone, argillaceous sandstone, matrix-rich sideritic sandstone, and organic-rich, slightly silty shale to argillaceous siltstone; no visible pores.

13,010-13,020 ft

Fine-grained sandstone; some fragments are slightly sideritic to sideritic; most cuttings are very small and lack any indication of bedding; rare poorly defined laminations in a few larger fragments; moderately well to moderately sorted; highly compacted, scattered deformed ductile grains; dominantly cemented by quartz overgrowths and authigenic clay; authigenic clay occurs as thin grain coatings, pore filling cement, and as an alteration of grains; fine crystalline siderite occurs as scattered crystals or sparse, erratically developed grain coatings; minor fine to medium crystalline ferroan dolomite that occurs as grain replacement and cement; minor titanium oxide as grain alteration/cement; trace replacement pyrite; irregularly distributed remnant intergranular pores (occur in some fragments); lower amount of secondary intraparticle pores; micropores are visible in some cuttings, and are associated with authigenic clay cement and altered grains.

Epifluorescence petrography reveals that micropores are present within intergranular authigenic clays of sandstone cuttings, and appear to form a large portion of the pore volume; a smaller amount of micropores are present in compacted argillaceous grains and altered grains. Minor quantity of organic-rich, slightly silty shale to argillaceous siltstone; trace quantities of argillaceous sandstone; no visible pores.

13,140-13,150 ft

Fine- to very fine-grained sandstone; a small proportion of cuttings are slightly sideritic to sideritic; no discernible bedding; moderately well sorted; highly compacted, common deformed ductile grains, including lithic fragments and mica; intergranular areas are dominantly cemented by quartz overgrowths with a subequal amount of authigenic clay cement; authigenic clay forms thin, discontinuous grain coatings, fills pores, and occurs as an alteration of grains; fine crystalline siderite occurs as scattered crystals to spars grain coatings, and rarely fills intergranular areas; scattered small crystals of ferroan dolomite are a grain replacement and cement; minor titanium oxide as grain alteration/cement; rare small remnant intergranular pores; trace amount of secondary intraparticle pores; micropores are locally visible within accumulations of authigenic clay cement and altered grains.

Much smaller amounts of organic-rich, slightly silty shale to argillaceous siltstone and matrix-rich, sideritic sandstone; no visible pores.

13,280-13,290 ft

Fine- to medium-grained sandstone; some cuttings are slightly sideritic to sideritic or dolomitic; most cuttings pieces contain no discernible bedding; a few cuttings contain crude, poorly defined bedding; moderately well to moderately sorted; highly compacted, common deformed ductile grains; dominantly cemented by quartz overgrowths that fill intergranular pores; a subordinate amount of authigenic clay has formed grain coatings that range from very discontinuous to fairly continuous; erratically developed fine crystalline siderite cement ranges from scattered small crystals, to sparse grain coatings, to filling intergranular areas; minor amount of scattered crystals of ferroan dolomite as a grain replacement and cement; locally common non-ferroan dolomite replacement/cement; titanium oxide is present as grain alteration and fine crystalline cement; trace replacement pyrite; micropores are locally visible within accumulations of authigenic clay cement and altered grains.

Much smaller amounts of argillaceous and/or replaced matrix, siderite-rich sandstone, siltstone to dolomitic siltstone, and organic-rich, slightly silty to silty shale; no visible pores.

13,350-13,360 ft

Fine-grained sandstone, with minor very fine-grained sandstone and rare medium-grained sandstone; sandstones are dominantly slightly sideritic to sideritic; no discernible bedding; moderately to moderately well sorted; highly compacted, scattered deformed ductile grains; intergranular areas are dominantly cemented by quartz overgrowths and fine crystalline siderite; siderite often forms sparse grain coatings and locally fills intergranular areas; lesser amount of authigenic clay that forms discontinuous grain coatings; scattered crystals of non-ferroan dolomite and ferroan dolomite occur as grain replacements and cements; minor titanium oxide as grain alteration and cement; trace replacement pyrite; no visible pores.

Minor organic-rich, slightly silty to silty shale; no visible pores.

13,810-13,820 ft

Fine-grained sandstone; a large portion of the cuttings are slightly sideritic to sideritic; rare very fine-grained sandstone; no discernible bedding; moderately to moderately well sorted; highly compacted, common deformed ductile grains; intergranular areas are dominantly cemented by quartz overgrowths and fine crystalline siderite; siderite often forms sparse grain coatings and replaces grains; a smaller quantity of authigenic clay that forms discontinuous grain coatings; erratically distributed fine to medium crystalline dolomite occurs as a grain replacement and cements; minor titanium oxide as grain alteration and cement; trace replacement pyrite; trace quantities of small intergranular and secondary intragranular pores; trace amount of micropores are locally visible in authigenic clays and altered grains.

Minor argillaceous sandstone and organic-rich, slightly silty to silty shale; no visible pores.

14,010-14,020 ft

Fine- to very fine-grained sandstone; some cuttings are slightly sideritic to sideritic; most fragments contain no discernible bedding; a few cuttings contain carbonaceous/micaceous/argillaceous laminations; moderately well sorted; highly compacted, common deformed ductile grains; intergranular areas are dominantly cemented by quartz overgrowths; fine crystalline siderite is locally common, often forming sparse grain coatings; siderite is also a partial grain replacement; a minor amount of authigenic clay is present as discontinuous grain coatings and as a grain alteration product; scattered fine to medium crystalline ferroan dolomite and less common non-ferroan dolomite occur as grain replacements and cements; minor titanium oxide as grain alteration and cement; trace amount of micropores is visible in altered/partially leached grains.

Trace to minor amounts of argillaceous sandstone and organic-rich, slightly silty to silty shale; no visible pores.

14,370-14,380 ft

Slightly sideritic to sideritic fine-grained sandstone; cuttings with little or no siderite are much less common; rare fragments grade to very fine-grained sandstone; no discernible bedding in most c uttings; rare fragments derived from beds with carbonaceous fragment-rich laminations; moderately to moderately well sorted; highly compacted, sparsely scattered deformed ductile grains; intergranular areas are dominantly cemented by fine crystalline siderite with lesser quartz overgrowth cement; siderite forms sparse grain coatings, fills intergranular areas, and partially replaces grains; a minor amount of authigenic clay is present as discontinuous grain coatings and as an alteration of grains; erratically distributed fine to medium crystalline ferroan dolomite and a trace of non-ferroan dolomite occur as grain replacements and cements; titanium oxide is present as grain alteration and cement; trace replacement pyrite; no visible pores using standard petrographic techniques.

Minor amount of argillaceous sandstone to siltstone; no visible pores.

14,470-14,480 ft

Dominantly variably organic-rich, slightly silty shale to argillaceous siltstone; locally sandy and/or sideritic; fragments vary from homogeneous to crudely layered, to distinctly laminated; sparsely scattered to abundant small carbonaceous fragments; no visible pores.

Common argillaceous, silty, fine-grained sandstone; many fragments are slightly sideritic to sideritic and/or dolomitic; poorly to very poorly sorted; depositional clay-rich matrix fills most intergranular areas and is partially replaced by siderite and dolomite; minor localized ferroan dolomite replacement and quartz overgrowths; trace amount of titanium oxide as grain alteration and cement; no visible pores.

Rare fine grained sandstone; no visible pores.

14,650-14,660 ft

14,850-14,860 ft

Fine- to very fine-grained sandstone; a small proportion of cuttings are slightly sideritic to sideritic; small size of cuttings obscures the determination of primary bedding structures; poorly defined bedding detected in a relatively large cuttings fragment; moderately to moderately well sorted; grains tightly packed, common deformed ductile grains; intergranular areas are dominantly cemented by quartz overgrowths and authigenic clay cement; authigenic clays form grain coatings and fill intergranular pores; fine crystalline siderite is locally common, occurring as cement and/or grain replacement associated with authigenic clays; erratically distributed crystals of ferroan dolomite replace grains and fill adjacent intergranular areas; minor amount of titanium oxide grain alteration/cement; solid hydrocarbon stains clays and fills micropores in large portion of cuttings; no visible pores using standard petrographic techniques.

Epifluorescence petrography reveals a minor amount of micropores are present within intergranular clays, mostly occurring in sandstone cuttings lacking solid hydrocarbon; cuttings with solid hydrocarbon contain very minor amounts of micropores; micropores are also present in compacted argillaceous grains and altered grains. Minor argillaceous sandstone to siltstone and organic-rich, silty shale to argillaceous siltstone; no visible pores.

15,200-15,210 ft

Fine- to very fine-grained sandstone; a few cuttings are slightly sideritic to sideritic; no detectable bedding in most cuttings, rare crude, poorly defined bedding; moderately well to moderately sorted; highly compacted, erratically scattered deformed ductile grains; intergranular areas variably cemented by quartz overgrowths and authigenic clay cement; authigenic clays form grain coatings and fill intergranular pores; fine crystalline siderite is locally common, occurring as grain coatings, filling intergranular areas, and replacing grains; irregularly distributed crystals of non-ferroan dolomite replace grains and fill adjacent intergranular areas; trace ferroan calcite cement/replacement; minor amount of titanium oxide present as an alteration of grains and as cement; solid hydrocarbon stains clays and fills micropores in a large portion of cuttings; no visible pores using standard petrographic techniques.

Common organic-rich, silty shale to argillaceous siltstone; minor amount of argillaceous sandstone cuttings; no visible pores.

16,490-16,500 ft

Fine- to very fine-grained sandstone; a portion of the cuttings are slightly sideritic to sideritic; no detectable bedding; rare solid hydrocarbon-lined microstylolites; moderately to moderately well sorted; highly compacted, scattered deformed ductile grains; dominantly cemented by quartz overgrowths and authigenic clay cement; authigenic clays form grain coatings, fill intergranular pores, and occur as a grain alteration; fine crystalline siderite is locally common, and often appears associated with authigenic clays; widely scattered crystals of ferroan dolomite replace grains and fill adjacent intergranular areas; minor titanium oxide as grain alteration and cement; solid hydrocarbon stains clays and fills micropores and small secondary pores in a large portion of cuttings; no visible pores using standard petrographic techniques.

Common organic-rich, silty shale to argillaceous siltstone; rare argillaceous sandstone cuttings; no visible pores.

16,710-16,720 ft

Fine-grained sandstone; several cuttings are slightly sideritic; a few cuttings grade to medium-grained sandstone and very fine-grained sandstone; no detectable bedding in most cuttings; poorly defined bedding visible in a few fragments; one cutting contains part of a graded bed (very fine sand to silt); moderately to moderately well sorted; highly compacted, scattered deformed ductile grains; dominantly cemented by quartz overgrowths, with a smaller quantity of authigenic clay cement; authigenic clays form thin, mostly discontinuous grain coatings; small amounts of fine crystalline siderite occur within accumulations of authigenic clay and within altered grains; irregularly distributed fine to medium crystalline ferroan dolomite replaces grains and fills adjacent intergranular areas; minor quantity of titanium oxide occurs as grain replacement/alteration and cement; trace replacement pyrite; solid hydrocarbon locally stains clays and fills micropores; trace micropores in altered/partially leached grains. Minor organic-rich, silty shale to argillaceous siltstone; rare argillaceous sandstone cuttings; no visible pores.

16,810-16,820 ft

Fine-grained sandstone; rarely grades to medium-grained sandstone; locally slightly sideritic; no detectable bedding; rare hydrocarbon lined microstylolites; moderately to moderately well sorted; highly compacted, scattered deformed ductile grains; dominantly cemented by quartz overgrowths which occur as tightly interlocking overgrowths that fill intergranular pores; authigenic clay cement has formed thin, discontinuous grain coatings, and also occurs as pore-filling cement and alteration of grains; fine crystalline siderite is present in several cuttings within intergranular areas, locally forming grain coatings and replacing grains; minor quantities of fine to medium crystalline ferroan dolomite grain replacement and authigenic titanium oxide as grain alteration/cement; trace replacement pyrite; minor solid hydrocarbon locally stains clays and fills micropores; trace amounts of intergranular pores, very small secondary pores, and micropores in authigenic clays and altered/partially leached grains. Epifluorescence petrography reveals micropores are present within accumulations of authigenic clay within intergranular areas of sandstone cuttings; micropores are also present in compacted argillaceous grains and altered grains. Minor organic-rich, silty shale to argillaceous siltstone; trace argillaceous sandstone cuttings; no visible pores.

16,890-16,990 ft

Slightly argillaceous to argillaceous, silty, very fine-grained sandstone to sandy siltstone; fabric varies from homogeneous to having a churned appearance, to containing carbonaceous laminations; poorly sorted; tightly compacted grains and matrix; matrix dominantly composed of detrital clay with common carbonaceous fragments; minor quartz overgrowth cement which occurs in areas lacking matrix and along grain contacts; minor quantities of non-ferroan dolomite, ferroan dolomite, siderite(?), authigenic titanium oxide, and pyrite as replacements of grains and matrix; no visible pores using standard petrographic techniques.

Minor organic-rich, silty shale to argillaceous siltstone, fine-grained sandstone, and slightly sideritic to sideritic, fine-grained sandstone; trace micropores in altered grains.

17,000-17,010 ft

Fine- to very fine-grained sandstone; fabric of individual cuttings pieces varies from homogeneous to bedded; bedding visible due to differences in grain size and alignment of elongate grains; moderately to moderately well sorted; highly compacted, common deformed ductile grains; intergranular areas are dominantly cemented by quartz overgrowth cement and authigenic clay cement which are present in somewhat variable amounts (generally clay increases as quartz decreases); titanium oxide is present as an alteration of grains and cement; scattered crystals of ferroan dolomite and non-ferroan dolomite as grain replacements and cements in adjacent intergranular areas; trace replacement pyrite; no visible pores using standard petrographic techniques.

Minor amounts of organic-rich, silty shale to argillaceous siltstone, siltstone, and argillaceous siltstone; no visible pores.

Petrography and Vitrinite Reflectance Measurements, Arkla Edwards B. 1-6 Well, Scott County, Arkansas

By Ed Ratchford and Peng Li

Arkansas Geological Survey

Bekki White, Director and State Geologist
Digital Compilation by Nathan Taylor
2008

PLATE 3

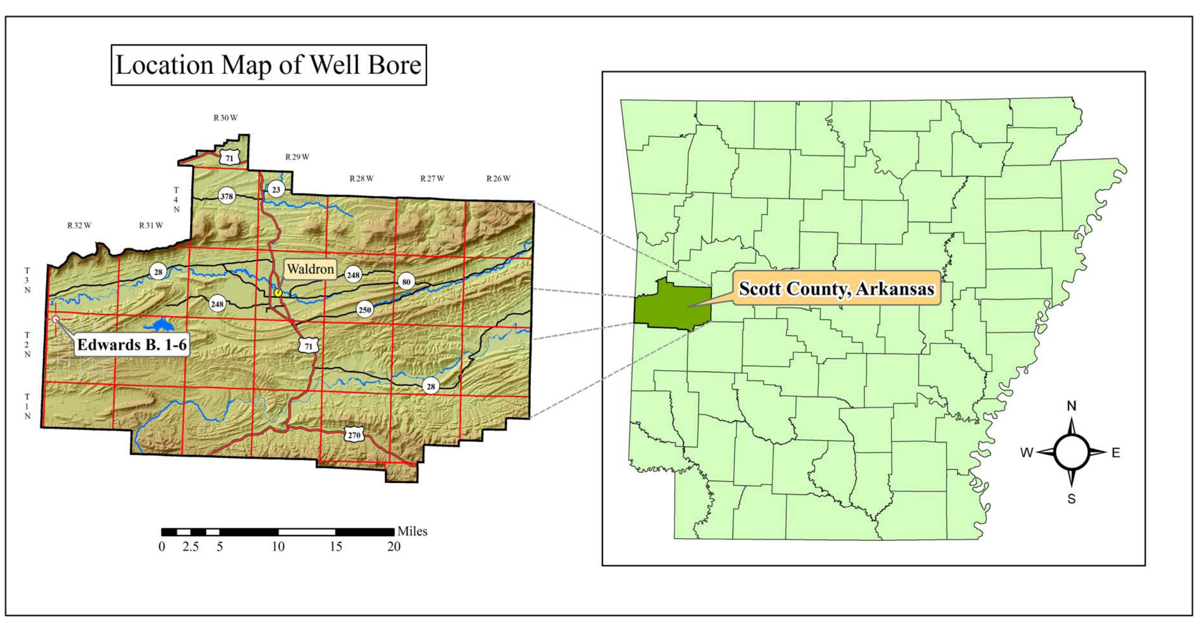
Plate 3 of 3

On the accompanying disk a manuscript file supplements Plate 3 as a separate Microsoft Word® document: Arkansas Geological Survey Information Circular 38

Vitrinite Reflectance Measurements - Arkla Edwards B. 1-6 Well

Depth (ft)	Ro (%)
9,010-9,020	5.61
9,440-9,450	5.72
10,250-10,350	5.71
10,920-10,960	5.68
11,470-11,500	5.72
12,370-12,400	5.72
12,900-12,950	5.96
13,400-13,450	6.47
13,950-14,000	6.67
14,470-14,520	6.65
14,950-15,000	6.68

Data from Geotrack Report # 967 in Appendix



Appendix 1. Summary of Routine Core Analyses for the Shell, C.M. Bettis No. 1-14 well.

Core Number	Sample Number	Sample Depth (feet)	Permeability, millidarcies		Porosity, percent		Grain Density (gm/cc)
			to Air	Klinkenberg	Ambient	800 psi	
1	1	9290.80		<0.0001	2.7	2.5	2.69
1	2	9291.85	0.0016	0.0003	3.4	3.3	2.71
1	3	9294.10	0.0009	0.0001	2.8	2.7	2.70
1	4	9297.50	0.0006	0.0001	2.7	2.5	2.74
1	5	10637.05	0.0035	0.0009	4.3	4.1	2.81
1	6	10659.00	0.0009	0.0002	5.2	5.1	2.80
1	7	11000.15		<0.0001	0.6	0.4	2.68
1	8	11007.85		<0.0001	0.6	0.5	2.68
1	9	11016.30	0.0002	<0.0001	2.4	2.2	2.69
1	10	11025.40		<0.0001	2.2	2.1	2.68
1	11	11033.75	0.0007	0.0001	2.6	2.5	2.68
1	12	11040.50		<0.0001	2.5	2.4	2.68
1	13	11048.40		<0.0001	1.4	1.3	2.68
1	14	11056.35		<0.0001	1.1	1.0	2.68
1	15	11067.30		<0.0001	0.8	0.6	2.69
1	16	11073.45		<0.0001	0.4	0.2	2.68
		Average values:	0.0012	0.0003	2.2	2.1	2.70

*** Data provided by Omni Laboratories Inc., Houston, TX.**

Appendix 2. Permeability and Porosity Data for Sandstone Gas Reservoirs in the Fairway Region, Arkansas.

Formation Series	Depth (ft)	Net Pay (ft)	ϕ (%)	K (md)	A (acres)	P (psi)
Upper Atoka	2400-5956	10-64 (33)	5-15 (11.3)	0.12-12.9 (1.5)	55-370 (165)	310-1796 (690)
Middle Atoka	2940-5950	6-85 (35)	8-15 (11.1)	0.04-1.35 (0.5)	40-135 (78)	70-2635 (1537)
Lower Atoka	3600-7950	6-52 (22)	8-16 (10.9)	0.13-24 (2.9)	50-610 (285)	700-1430 (947)
Morrow	5300-8100	10-50 (28)	7-14 (11.1)	0.2-42 (1.8)	75-520 (260)	1550-2600 (2000)

*From Chen and Robbins (1991)

STATE	COUNTY	FIELD	DEPTH	PAY	POR	PERM	POR RANGE
LOWER ATOKA DISTRIBUTARY CHANNEL							
AR	LOGAN	AETNA	4705	55	N/A	N/A	0.13-24
AR	LOGAN	AETNA	5075	30	N/A	N/A	0.13-24
AR	LOGAN	AETNA	5050	45	N/A	N/A	0.13-24
AR	POPE	DOVER	3200	25	17.00	N/A	0.13-24
AR	SEBASTIAN	EWING	6150	20	9.00	N/A	0.13-24
AR	POPE	FURGERSON	5210	20	11.5	N/A	0.13-24
AR	CRAWFORD	KIBLER-WILLIAMS	4520	20	14.00	N/A	0.13-24
AR	FRANKLIN	LONE ELM	2775	20	15.00	N/A	0.13-24
AR	CRAWFORD	MASSARD	5300	40	16.00	N/A	0.13-24
AR	POPE	ROSS	4300	45	17.50	N/A	0.13-24
AR	JOHNSON	ROSS	3550	15	17.50	N/A	0.13-24
AR	LOGAN	SPADRA	5350	20	15.00	N/A	0.13-24
AR	JOHNSON	SPADRA	5700	30	15.00	N/A	0.13-24
AR	LOGAN	UNION CITY-ARK	5500	25	10.50	N/A	0.13-24
MIDDLE ATOKA DEEP WATER SANDSTONE							
AR	JOHNSON	SPADRA	4500	25	15.00	N/A	0.04-1.35
UPPER ATOKA TRANSGRESSIVE SANDSTONE							
AR	FRANKLIN	CECIL	3278	30	14.50	N/A	0.12-12.9
AR	SEBASTIAN	CECIL	1958	35	14.50	N/A	0.12-12.9
AR	JOHNSON	CLARKSVILLE	2760	25	10.00	N/A	0.12-12.9
AR	SEBASTIAN	GRAGG	3990	25	10.50	N/A	0.12-12.9
AR	JOHNSON	KNOXVILLE	3410	55	12.00	N/A	0.12-12.9
AR	JOHNSON	ROSS	2410	45	17.50	N/A	0.12-12.9

* Modified from Brown and Woodward (1993)

SEC 11-8N-22W GEO. L. HARDGRAVE WELL #1, JOHNSON COUNTY

DEPTH (FT)	POROSITY (%)	PERMEABILITY (MD)
3,568	5.9	6.5
3,569	7.1	5.9
3,570	11.5	8.0

SEC 3-8N-22W HICKS #1, JOHNSON COUNTY

DEPTH (FT)	POROSITY (%)	PERMEABILITY (MD)
3251.5	8.32	3.65
3252.5	11.16	5.91
3253.5	7.99	0.11
3254.5	5.51	1.12
3255.5	13.19	7.55

* Data from unpublished files, XTO Energy Inc., Dallas, TX

VITRINITE REFLECTANCE DATA FROM THE EDWARDS B NO. 1-6 AND HUNT USA NO. 1-1 WELLS, ARKOMA BASIN

GEOTRACK REPORT #967

Report prepared for the South Western Energy, Houston Texas

Report prepared by:	I. R. Duddy
VR data:	Prof Alan Cook, Keiraville Konsultants

July 2006

VITRINITE REFLECTANCE DATA FROM THE EDWARDS B NO. 1-6 AND HUNT USA NO. 1-1 WELLS, ARKOMA BASIN

GEOTRACK REPORT #967

1. Introduction

1.1 Aims and report structure

This report provides new vitrinite reflectance determinations carried out on 11 samples from the **Edwards B No 1-6 well** and 11 samples from **Hunt USA No 1-1** well provided by Jim Seefeldt of South Western Energy. Results and full details are summarised in Table A.2 (Appendix A). Details of the methods employed are described in Sections A.2 and A.3 in Appendix A.

1.2 VR results and interpretation

The VR results from the **Edwards B No 1-6 well** and **Hunt USA No 1-1** are plotted against depth in Figure 1.1.

The VR values from both wells are very similar and show overlapping trends with depth as shown in Figure 1.1.

It is also clear that all of the VR values are very high ranging from ~5.6 to 6.7% Romax, well beyond the limit for preservation of "conventional" dry gas. These high values are beyond the current kinetic calibrations of VR to maximum paleotemperature which is limited to VR values up to ~4.8 % Ro which is equivalent to ~320°C for a heating rate of 1°C/ Myr. Thus, the only conclusion that can be made concerning the thermal history is that the entire sampled sequence cooled from in excess of 320°C at some time after deposition.

1.3 Recommendations

It is recommended that consideration be given to using zircon fission track analysis to determine the absolute timing at which these high maturities were reached. A limited number (say 2) of suitable sandstone samples from each well could provide this key information. Please contact Geotrack for a specific sampling stratgey and quotation

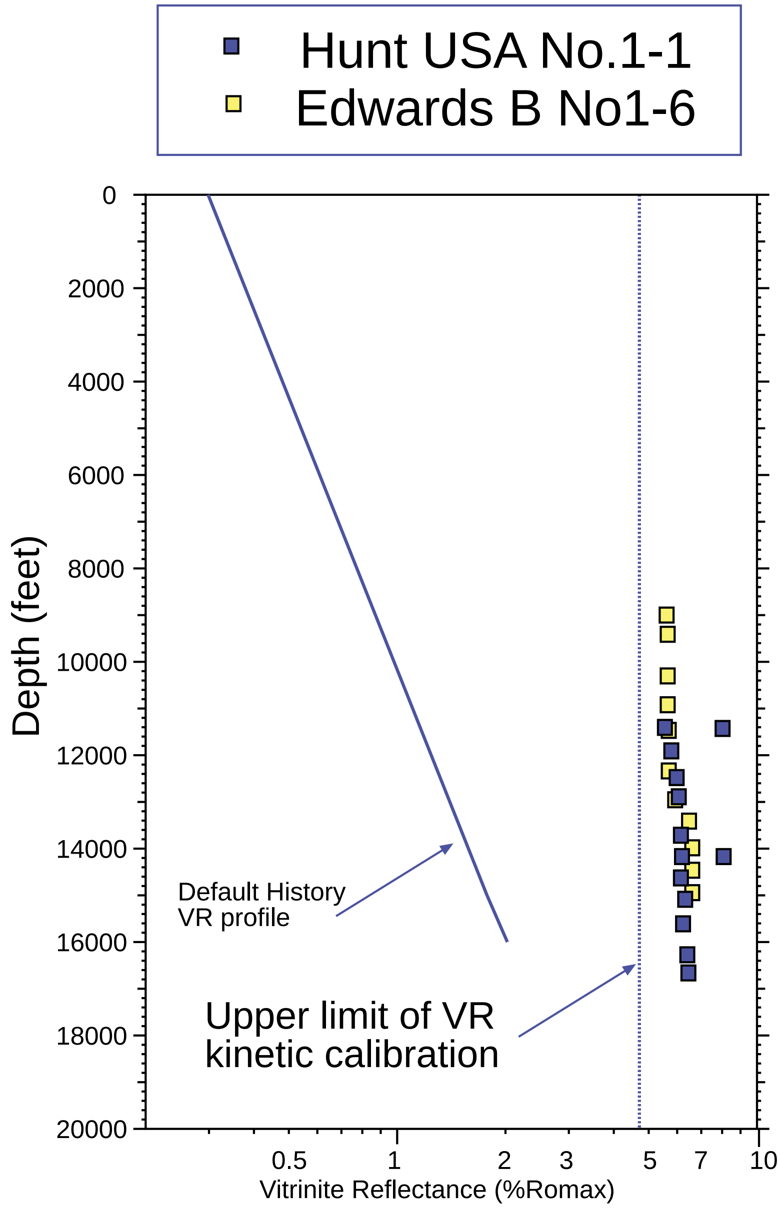


Figure 1.1: Measured equivalent vitrinite reflectance (Table A.2, Appendix A) in the **Edwards B No 1-6 and Hunt USA No 1-1 wells** plotted against depth. Also shown is a VR profile predicted from the "Default Thermal History", i.e., the profile expected if all units throughout the well are currently at their maximum temperatures since deposition (see Section 2.1). The predicted profile is based on an assumed present-day thermal gradient of 30°C/km and surface temperature of 20°C.

The VR results from both wells are very high, beyond the uper limit of kinetic calibration of VR data, and they are also very similar, plotting on the same general depth trend.

It is also clear that all VR values plot well above the Default History VR profile indicating that the entire sampled sequence in each well has cooled from maximum paleotemperatures higher than the present-day temperatures at some time since deposition.

Note that the two high values may be the inertinite maceral or are contacted altered – see maceral descriptions in Appendix A for analysts comments.

APPENDIX A

Vitrinite Reflectance Measurements

A.1 Introduction

New vitrinite reflectance determinations were carried out on 11 samples from the Edwards B No 1-6 well and 11 samples from Hunt USA No 1-1 well provided by Jim Seefeldt of South Western Energy. Results and full details are summarised in Table A.2. Details of the methods employed are described in sections A.2 and A.3 below.

A.2 New vitrinite reflectance determinations and equivalent VR data

Samples

Samples were submitted for vitrinite reflectance determination to Keiraville Konsultants, Australia. Results and sample details are summarised in Table A.2, while supporting data, including maceral descriptions and raw data sheets, are presented in the following pages.

Equipment

Leitz MPV1.1 photometer equipped with separate fluorescence illuminator, Swift point counter. Reflectance standards: spinel 0.42%, YAG 0.91%, GGG 1.72%, SiC standard for cokes and masked uranyl glass for measurement of intensity (I) in fluorescence mode. With the Keiraville Konsultants equipment, it is possible to alternate from reflectance to fluorescence mode to check for associated fluorescing liptinite, or importantly with some samples, to check for bitumen impregnation, or the presence, intensity, and source of oil-cut.

Sample preparation

Samples are normally mounted in cold setting polyester resin and polished using Cr_20_3 and Mg0 polishing powders. Epoxy resins or araldite can be used if required. "Whole rock" samples are normally used but demineralisation can be undertaken. Large samples of coals and cokes can be mounted and examined.

Vitrinite Reflectance measurement

The procedure used generally follows Australian Standard (AS) 2486, but has been slightly modified for use with dispersed organic matter (DOM). For each sample, a minimum of 25 fields is measured (the number may be less if vitrinite is rare or if a limited number of particles of vitrinite is supplied, as may be the case with hand-picked samples). If wide dispersal of vitrinite reflectance is found, the number of readings (N) is increased until a stable mean is obtained.

Vitrinite identification is made primarily on textural grounds, and this allows an independent assessment to be made of cavings and re-worked vitrinite populations. Histograms are only used for population definition when a cavings population significantly overlaps the range of the indigenous population. Where such data provides additional information, the mean maximum reflectance of inertinite and/or the mean maximum reflectance of liptinite (exinite) is reported. For each field, the maximum reflectance position is located and the reading recorded. The stage is then rotated by 180° which should give the same reading. In practice, the readings are seldom identical because of stage run-out and slight surface irregularities. If the readings are within ±5% relative, they are accepted. If not, the cause of the difference is sought and the results rejected. The usual source of differences is surface relief. The measurement of both maxima results in a total of 50 measurements being taken for the 25 fields reported. Thus, the 50 readings consist of 25 pairs of closely spaced readings which provide a check on the levelling of the surface and hence additional precision.

As the vitrinite reflectance measurements are being made, the various features of the samples are noted on a check sheet to allow a sample description to be compiled. When the reflectance measurements are complete, a thorough check is made of liptinite fluorescence characteristics. At the same time, organic matter abundance is estimated using a global estimate, a grain count method or point count method as required.

Data presentation

Individual sample results are reported in the following format:

KK#[*1] Ref#[*2]	Depth (ft)	R_V max[*3]	Range[*4]	N[*5]
v1324	3106	0.79	0.64 - 0.91	25
873-1.1	$R_I$max[*6]	1.68	1.02 – 1.98	12

*1 Keiraville Konsultant reference number
*2 Geotrack sample number
*3 Mean of all the maximum reflectance readings obtained.
*4 Lowest $R_o$max and highest $R_o$max of the population considered to represent the first generation vitrinite population.
*5 Number of fields measured (Number of measurements = 2N because 2 maximum values are recorded for each field).
*6 Reflectance of the inertinite maceral (if present) – can be used to estimate an equivalent VR level as shown in Table A.1b.

Methods - Organic matter abundance and type.

After completion of vitrinite reflectance readings, the microscope is switched to fluorescence-mode and an estimate made of the abundance of each liptinite maceral. Fluorescence colours are also noted (BG 3 long UV excitation, TK400 dichroic mirror and a K490 barrier filter). The abundances are estimated using comparison charts. The categories used for liptinite (and other components) are:

Descriptor	%	Source potential
Absent	0	None
Rare	<0.1	Very poor
Sparse	0.1<x<0.5	Poor to fair
Common	0.5<x<2.0	Fair to good
Abundant	2.0<x<10.0	Good to very good
Major	10.0<x<40.0	Very good (excellent if algal)
Dominant	>40.0	Excellent

Dispersed Organic Matter (DOM) composition

At the same time as liptinite abundances are estimated, total DOM, vitrinite and inertinite abundances are estimated and reported in the categories listed above. Liptinite (exinite) fluorescence intensity and colour, lithology and a brief description of organic matter type and abundance are also recorded in a further column. Coal is described separately from dispersed organic matter (DOM). These data can be used to estimate the specific yield of the DOM and form a valuable adjunct to TOC data.

Lithological composition

The lithological abundances are ranked. For cuttings, these data can be useful in conjunction with geophysical logs in assessing the abundance and nature of cavings. For cores, it provides a record of the lithology examined and of the lithological associations of the organic matter.

Coal abundance and composition

Where coals are present, their abundance is recorded and their composition is reported as microlithotypes thus:

Coal major, **V**itrinite>**I**nertinite>**E**xinite, Clarodurite>vitrite>clarite>inertite.

These data give an approximate maceral composition and information about the organic facies of the coal. Where coal is a major or dominant component, and more precise maceral composition data are required, point count analyses should be requested. However, the precision of the original sampling is commonly a limiting factor in obtaining better quality data.

Abundance factor analysis

Especially where cuttings samples are used, abundance factor analyses are used to obtain an assessment of the maceral assemblages in the various lithologies. This can be done by a combination analysis using a point counter, but a large number of categories is required, and the precision is low if DOM is less than about 10%. For an abundance factor analysis (for core, 50 microscope fields of view) we assess the abundance of DOM, coal and shaly coal in 50 grains. The data can be used to plot DOM and coal abundance profiles.

Analyst/Advisor: Professor A.C. Cook

Prior to transmittal of final results, all samples are examined and checked by A.C. Cook who has more than 30 years' experience of work on coals, cokes, source rocks and source rock maturation.

A.3 Integration of vitrinite reflectance data with AFTA

Vitrinite reflectance is a time-temperature indicator governed by a kinetic response in a similar manner to the annealing of fission tracks in apatite as described in Appendix C. In this study, vitrinite reflectance data are interpreted on the basis of the distributed activation energy model describing the evolution of VR with temperature and time described by Burnham and Sweeney (1989), as implemented in the BasinMod™ software package of Platte River Associates. In a considerable number of wells from around the world, in which AFTA has been used to constrain the thermal history, we have found that the Burnham and Sweeney (1989) model gives good agreement between predicted and observed VR data, in a variety of settings.

As in the case of fission track annealing, it is clear from the chemical kinetic description embodied in equation 2 of Burham and Sweeney (1989) that temperature is more important than time in controlling the increase of vitrinite reflectance. If the Burham and Sweeney (1989) distributed activation energy model is expressed in the form of an Arrhenius plot (a plot of the logarithm of time versus inverse absolute temperature), then the slopes of lines defining contours of equal vitrinite reflectance in such a plot are very similar to those describing the kinetic description of annealing of fission tracks in Durango apatite developed by Laslett et al. (1987), which is used to interpret the AFTA data in this report. This feature of the two quite independent approaches to thermal history analysis means that for a particular sample, a given degree of fission track annealing in apatite of Durango composition will be associated with the same value of vitrinite reflectance regardless of the heating rate experienced by a sample. Thus paleotemperature estimates based on either AFTA or VR data sets should be equivalent, regardless of the duration of heating. As a guide, Table A.1a gives paleotemperature estimates for various values of VR for two different heating times.

One practical consequence of this relationship between AFTA and VR is, for example, that a VR value of 0.7% is associated with total annealing of all fission tracks in apatite of Durango composition, and that total annealing of all fission tracks in apatites of more Chlorine-rich composition is accomplished between VR values of 0.7 and ~0.9%.

Furthermore, because vitrinite reflectance continues to increase progressively with increasing temperature, VR data allow direct estimation of maximum paleotemperatures in the range where fission tracks in apatite are totally annealed (generally above ~110°C) and where therefore AFTA only provides minimum estimates. Maximum paleotemperature estimates based on vitrinite reflectance data from a well in which most AFTA samples were totally annealed will allow constraints on the paleogeothermal gradient that would not be possible from AFTA alone. In such cases the AFTA data should allow tight constraints to be placed on the time of cooling and also the cooling history, since AFTA parameters will be dominated by the effects of tracks formed after cooling from maximum paleotemperatures. Even in situations where AFTA samples were not totally annealed, integration of AFTA and VR can allow paleotemperature control over a greater range of depth, e.g. by combining AFTA from sand-dominated units with VR from other parts of the section, thereby providing tighter constraint on the paleogeothermal gradient.

Equivalent vitrinite reflectance estimation from inertinite reflectance

Inertinite is another common organic maceral with a reflectance higher than that of vitrinite. The relationship between vitrinite and inertinite reflectance can be rather variable from province to province and with stratigraphic age and there is no universal kinetic relationship available. However, comparison of vitrinite and inertinite reflectance from the same samples has allowed Geotrack to develop a reasonable calibration to provide an equivalent vitrinite reflectance level from inertinite reflectance. The correlation table is provided in Table A.1B.

References

Burnham, A.K. and Sweeney, J.J. (1989). A chemical kinetic model of vitrinite reflectance maturation. *Geochim. et Cosmochim. Acta*, 53, 2649-2657.

Laslett, G.M., Green, P.F., Duddy, I.R. and Gleadow, A.J.W. (1987). Thermal annealing of fission tracks in apatite 2. A quantitative analysis. *Chem. Geol. (Isot. Geosci.Sect.)*, 65, 1-13.

Table A.1a: Paleotemperature - vitrinite reflectance nomogram based on Equation 2 of Burnham and Sweeney (1989)

Paleotemperature (°C / *°F*)	Vitrinite Reflectance (%) 1 Ma Duration of heating	Vitrinite Reflectance (%) 10 Ma Duration of heating
40 / *104*	0.29	0.32
50 / *122*	0.31	0.35
60 / *140*	0.35	0.40
70 / *158*	0.39	0.45
80 / *176*	0.43	0.52
90 / *194*	0.49	0.58
100 / *212*	0.55	0.64
110 / *230*	0.61	0.70
120 / *248*	0.66	0.78
130 / *266*	0.72	0.89
140 / *284*	0.81	1.04
150 / *302*	0.92	1.20
160 / *320*	1.07	1.35
170 / *338*	1.23	1.55
180 / *356*	1.42	1.80
190 / *374*	1.63	2.05
200 / *392*	1.86	2.33
210 / *410*	2.13	2.65
220 / *428*	2.40	2.94
230 / *446*	2.70	3.23

Table A.1b: Equivalent vitrinite reflectance estimated from inertinite reflectance (Geotrack unpublished correlation).

Measured Inertinite Reflectance (%)	Calculated Vitrinite Reflectance (%)
0.88	0.27
0.95	0.3
1.14	0.4
1.31	0.5
1.45	0.6
1.57	0.7
1.68	0.8
1.78	0.9
1.87	1.0
1.97	1.1
2.07	1.2
2.18	1.3
2.31	1.4
2.46	1.5
2.63	1.6
2.84	1.7
3.08	1.8
3.37	1.9
3.70	2.0
4.20	3.0
6.00	5.0

Table A.2: Vitrinite reflectance sample details and results - well samples from Arkoma Basin (Geotrack Report #967)

Sample number	Depth (m)	Sample type	VR (Range) %	N
Edwards 'B' No.1-6				
GC967-1.1	2746-2749 *(9010-9020')*	cuttings	5.61 (5.13-5.89)	9
GC967-2.1	2877-2880 *(9440-9450')*	cuttings	5.72 (5.26-6.07)	25
GC967-3.1	3124-3155 *(10250-10350')*	cuttings	5.71 (5.42-6.16)	13
GC967-4.1	3328-3341 *(10920-10960')*	cuttings	5.68 (5.36-6.13)	8
GC967-5.1	3496-3505 *(11470-11500')*	cuttings	5.72 (5.47-5.90)	10
GC967-6.1	3770-3780 *(12370-12400')*	cuttings	5.72 (5.32-6.09)	6
GC967-7.1	3932-3947 *(12900-12950')*	cuttings	5.96 (5.82-6.16)	3
GC967-8.1	4084-4100 *(13400-13450')*	cuttings	6.47 (6.18-6.90)	16
GC967-9.1	4252-4267 *(13950-14000')*	cuttings	6.67 (6.24-7.22)	18
GC967-10.1	4410-4426 *(14470-14520')*	cuttings	6.65 (6.20-7.29)	20
GC967-11.1	4557-4572 *(14950-15000')*	cuttings	6.68 (6.38-7.12)	16

Table A.2: Continued

Sample number	Depth (m)	Sample type		VR (Range) %	N
Hunt USA No.1-1					
GC967-12.1	3475-3490	cuttings	I	8.05	3
	(11400-11450')			(7.88-8.38)	
			II	5.69	25
				(5.15-6.25)	
GC967-13.1	3627-3633	cuttings		5.84	16
	(11900-11920')			(5.56-6.20)	
GC967-14.1	3795-3810	cuttings		6.04	15
	(12450-12500')			(5.56-6.56)	
GC967-15.1	3917-3932	cuttings		6.08	25
	(12850-12900')			(5.73-6.59)	
GC967-16.1	4164-4176	cuttings		6.18	13
	(13660-13700')			(5.93-6.71)	
GC967-17.1	4310-4319	cuttings	I	8.13	3
	(14140-14170')			(7.87-8.33)	
			II	6.23	25
				(5.84-6.56)	
GC967-18.1	4453-4459	cuttings		6.19	12
	(14610-14630')			(6.02-6.58)	
GC967-19.1	4587-4606	cuttings		6.35	10
	(15050-15110')			(5.91-6.80)	
GC967-20.1	4755-4770	cuttings		6.28	19
	(15600-15650')			(5.99-6.76)	
GC967-21.1	4959-4968	cuttings		6.43	13
	(16270-16300')			(6.09-7.33)	
GC967-22.1	5069-5081	cuttings		6.50	25
	(16630-16670')			(6.13-7.18)	

Note: Some samples may contain both vitrinite and inertinite. Only vitrinite data is shown.

SOUTH WESTERN
Edwards 'B' No. 1-6

GC967 KK # Ref #.	Depth (ft)	$\overline{R}_{vmax}$	Range	SD	N	Sample description including liptinite fluorescence, maceral abundances, mineral fluorescence
L0830 -1.1 Ctgs	9010-20	5.61	5.13-5.89	0.221	9	Fluorescing liptinite absent. (Sandstone>artificial composites>. ?igneous rocks. Dom rare, V>I. Vitrinite and inertinite rare, liptinite absent. Abundant mica in the sample, probably a mud additive. Mineral fluorescence none. Iron oxides sparse. Pyrite sparse.)
L0831 -2.1 Ctgs	9440-50	5.72	5.26-6.07	0.201	25	Fluorescing liptinite absent. (Claystone>artificial composites>. micaceous sandstone>?igneous rocks. Dom common, V>I. Vitrinite common, inertinite sparse, liptinite absent. Mica minerals common. Walnut shell additives sparse. Mineral fluorescence pervasive dull orange to none. Iron oxides rare. Pyrite sparse.)
L0832 -3.1 Ctgs	10250-350	5.71	5.42-6.16	0.191	13	Fluorescing liptinite absent. (Micaceous sandstone>siltstone> claystone>?igneous rocks>carbonate. Dom sparse, V>I. Vitrinite sparse, inertinite rare, liptinite absent. Mica minerals abundant. Mineral fluorescence pervasive dull orange to none. Iron oxides rare. Pyrite sparse.)
L0833 -4.1 Ctgs	10920-960	5.68	5.36-6.13	0.242	8	Fluorescing liptinite absent. (Claystone>micaceous sandstone> siltstone>?igneous rocks. Dom rare, V>I. Vitrinite and inertinite rare, liptinite absent. Mica minerals abundant. Mineral fluorescence pervasive dull orange to none. Iron oxides rare. Pyrite sparse.)
L0834 -5.1 Ctgs	11470-500	5.72	5.47-5.90	0.144	10	Fluorescing liptinite absent. (Micaceous sandstone> claystone> artificial composites>?igneous rocks. Dom rare, V>I. Vitrinite and inertinite rare, liptinite absent. Mica minerals abundant. Mineral fluorescence pervasive dull orange to none. Iron oxides rare. Pyrite sparse.)
L0835 -6.1 Ctgs	12370-400	5.72	5.32-6.09	0.262	6	Fluorescing liptinite absent. (Micaceous sandstone> siltstone> claystone>?igneous rocks. Dom rare, V>I. Vitrinite and inertinite rare, liptinite absent. Mica minerals common. Mineral fluorescence pervasive dull orange to none. Iron oxides rare. Pyrite rare.)
L0836 -7.1 Ctgs	12900-950	5.96	5.82-6.16	0.151	3	Fluorescing liptinite absent. (Claystone>micaceous sandstone> siltstone. Dom rare, V>I. Vitrinite and inertinite rare, liptinite absent. Mica minerals abundant. Mineral fluorescence pervasive dull orange to none. Iron oxides rare. Pyrite rare.)
L0837 -8.1 Ctgs	13400-450	6.47	6.18-6.90	0.184	16	Fluorescing liptinite absent. (Claystone>micaceous sandstone> siltstone>?igneous rocks>carbonate. Dom rare to sparse, V>I. Vitrinite rare to sparse, inertinite rare, liptinite absent. Vitrinite bireflectance, measured from a single grain, is moderate with a bireflectance ratio of 0.33. Mica minerals abundant. Mineral fluorescence pervasive dull orange to none. Iron oxides rare. Pyrite rare.)

SOUTH WESTERN

Edwards ‘B’ No. 1-6, p2

GC967 KK # Ref #.	Depth (ft)	$\overline{R}_{v\max}$	Range	SD	N	Sample description including liptinite fluorescence, maceral abundances, mineral fluorescence
L0838 -9.1 Ctgs	13950-000	6.67	6.24-7.22	0.275	18	Fluorescing liptinite absent. (Claystone>siltstone>sandstone>. ?igneous rocks. Dom sparse, V>I. Vitrinite sparse, inertinite rare, liptinite absent. Vitrinite bireflectance moderate with a mean bireflectance ratio of 0.57 and a range of 0.46 to 0.67. Common mica in the sample, probably a mud additive. Mineral fluorescence none. Iron oxides rare. Pyrite sparse.)
L0839 -10.1 Ctgs	14470-520	6.65	6.20-7.29	0.258	20	Fluorescing liptinite absent. (Sandstone>siltstone>claystone> ?igneous rocks. Dom sparse, V>I. Vitrinite sparse, inertinite rare, liptinite absent. Common mica in the sample, probably a mud additive. Mineral fluorescence none. Iron oxides rare. Pyrite sparse.)
L0840 -11.1 Ctgs	14950-000	6.68	6.38-7.12	0.251	16	Fluorescing liptinite absent. (Siltstone>sandstone>claystone> ?igneous rocks. Dom sparse, V>I. Vitrinite sparse, inertinite rare, liptinite absent. Common mica in the sample, probably a mud additive. Mineral fluorescence none. Iron oxides rare. Pyrite sparse.)

The possible igneous rocks may be a mud additive. They have doleritic textures, but do not contain iron and titanium oxides, which suggests that they are not natural occurrences.

SOUTH WESTERN

Hunt USA No. 1-1

GC967 KK # Ref #.	Depth (ft)	$\overline{R}_{vmax}$	Range	SD	N	Sample description including liptinite fluorescence, maceral abundances, mineral fluorescence
L0841 -12.1 Ctgs	11400-450	P1 8.05 P2 5.69	7.88-8.38 5.15-6.25	0.231 0.283	3 25	Fluorescing liptinite absent. (Siltstone>sandstone>claystone. Dom common to abundant, V>I. Vitrinite and inertinite common, liptinite absent. Population 1, measured from telovitrinite, shows very low bireflectance and probably is a part of the population 2. Diffuse organic matter abundant in siltstone. Mineral fluorescence weak dull orange to none. Iron oxides sparse. Pyrite sparse.)
L0842 -13.1 Ctgs	11900-920	5.84	5.56-6.20	0.186	16	Fluorescing liptinite absent. (Siltstone>claystone>sandstone. Dom common, V>I. Vitrinite sparse to common, inertinite sparse, liptinite absent. Diffuse organic matter common in siltstone. Mineral fluorescence pervasive weak dull orange to moderate orange. Iron oxides sparse. Pyrite sparse.)
L0843 -14.1 Ctgs	12450-500	6.04	5.56-6.56	0.262	15	Fluorescing liptinite absent. (Claystone>>sandstone>siltstone. Dom common, I>V. Inertinite common, vitrinite sparse, liptinite absent. Diffuse organic matter common in siltstone. Mineral fluorescence pervasive weak dull orange to moderate orange. Iron oxides common. Pyrite rare.)
L0844 -15.1 Ctgs	12850-900	6.08	5.73-6.59	0.262	25	Fluorescing liptinite absent. (Claystone>>siltstone>sandstone> carbonate. Dom common, V>I. Vitrinite sparse to common, inertinite sparse, liptinite absent. Diffuse organic matter common in siltstone. Mineral fluorescence pervasive weak dull orange to moderate orange. Iron oxides sparse. Pyrite sparse.)
L0845 -16.1 Ctgs	13660-700	6.18	5.93-6.71	0.225	13	Fluorescing liptinite absent. (Claystone>siltstone>carbonate. Dom sparse, V>I. Vitrinite and inertinite sparse, liptinite absent. Vitrinite bireflectance, measured from a single grain, is low with a bireflectance ratio of 0.13. Diffuse organic matter present in siltstone. Mineral fluorescence pervasive weak dull orange to moderate orange. Iron oxides sparse. Pyrite rare.)
L0846 -17.1 Ctgs	14140-170	P1 8.13 P2 6.23	7.87-8.33 5.84-6.56	0.192 0.173	3 25	Fluorescing liptinite absent. (Sandstone>siltstone>claystone. Dom common to abundant, V>I. Vitrinite common, inertinite sparse, liptinite absent. Population 1, measured from ?telovitrinite shows a very low bireflectance and probably represents part of the population 2 possibly with contact alternation . Mineral fluorescence pervasive weak dull orange to none. Iron oxides sparse. Pyrite rare.)
L0847 -18.1 Ctgs	14610-630	6.19	6.02-6.58	0.146	12	Fluorescing liptinite absent. (Claystone>siltstone>cclaystone> carbonate. Dom sparse to common, V>I. Vitrinite and inertinite sparse, liptinite absent. Diffuse organic matter present in siltstone. Mineral fluorescence pervasive weak dull orange to none. Iron oxides rare. Pyrite sparse.)
L0848 -19.1 Ctgs	15050-110	6.35	5.91-6.80	0.254	10	Fluorescing liptinite absent. (Claystone>siltstone>cclaystone> carbonate. Dom sparse, I>V. Inertinite sparse, vitrinite rare to sparse, liptinite absent. Diffuse organic matter present in fine grained lithologies. Mineral fluorescence pervasive weak dull orange to none. Iron oxides sparse. Pyrite sparse.)

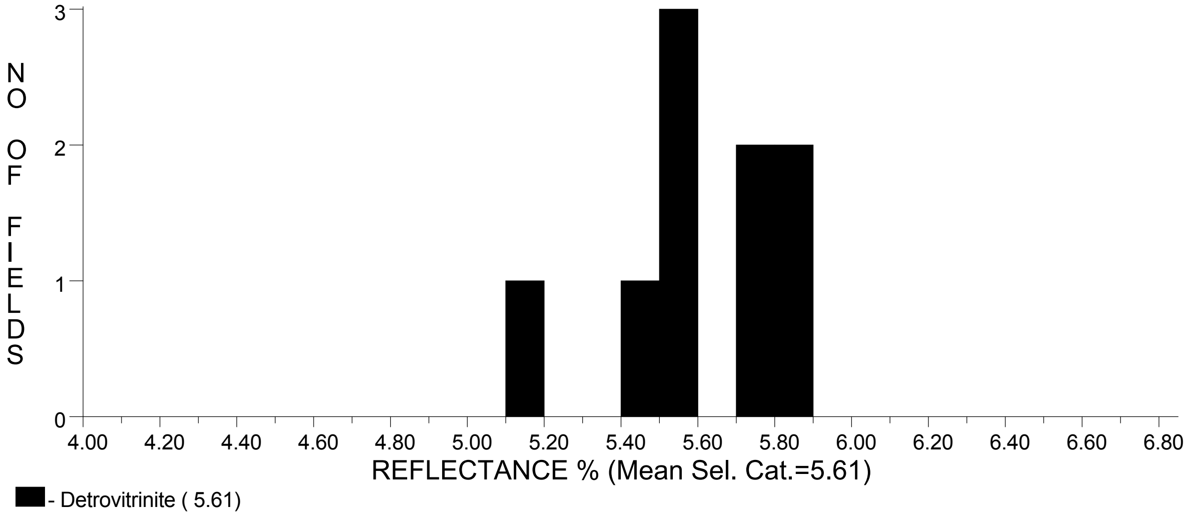
SOUTH WESTERN
Hunt USA No. 1-1, p2

GC967 KK # Ref #.	Depth (ft)	$\overline{R}_{vmax}$	Range	SD	N	Sample description including liptinite fluorescence, maceral abundances, mineral fluorescence
L0849 -20.1 Ctgs	15600-650	6.28	5.99-6.76	0.232	19	Fluorescing liptinite absent. (Claystone>siltstone>sandstone. Dom common, I>V. Inertinite and vitrinite sparse, liptinite absent. Diffuse organic matter abundant in siltstone. Mineral fluorescence weak dull orange to none. Iron oxides sparse. Pyrite sparse.)
L0850 -21.1 Ctgs	16270-300	6.43	6.09-7.33	0.336	13	Fluorescing liptinite absent. (Claystone>artificial composites> sandstone>siltstone. Dom sparse, V>I. Vitrinite sparse, inertinite rare to sparse, liptinite absent. Diffuse organic matter abundant in siltstone. Mineral fluorescence weak dull orange to none. Iron oxides rare. Pyrite sparse.)
L0851 -22.1 Ctgs	16630670	6.50	6.13-7.18	0.217	25	Fluorescing liptinite absent. (Claystone>artificial composites> carbonate>siltstone>sandstone. Dom sparse, V>I. Vitrinite sparse, inertinite rare, liptinite absent. Mica minerals common and may represent mud additives. Mineral fluorescence weak dull orange to none. Iron oxides rare. Pyrite sparse.)

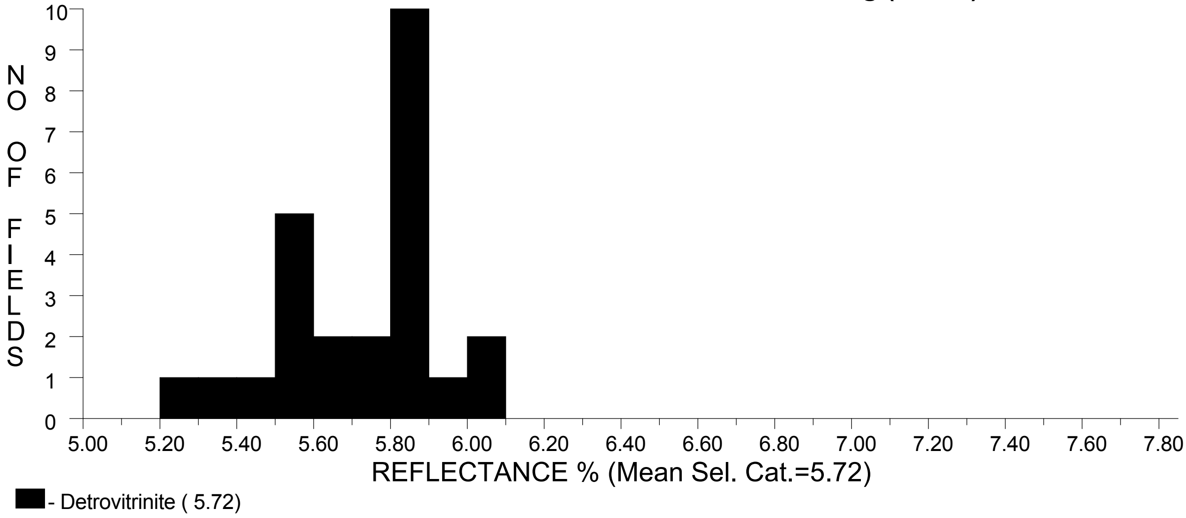
All of the section sampled is super-mature. Two populations were found at 14,140', the lower is consistent with other populations. The higher reflecting population could be contact altered, or inertinite but it is unusual to find inertinite with a reflectance higher than that of vitrinite at this vitrinite reflectance level. The vitrinite reflectance gradient is relatively low in relation to the high vitrinite reflectance values found.

ACC 21 June 2006.

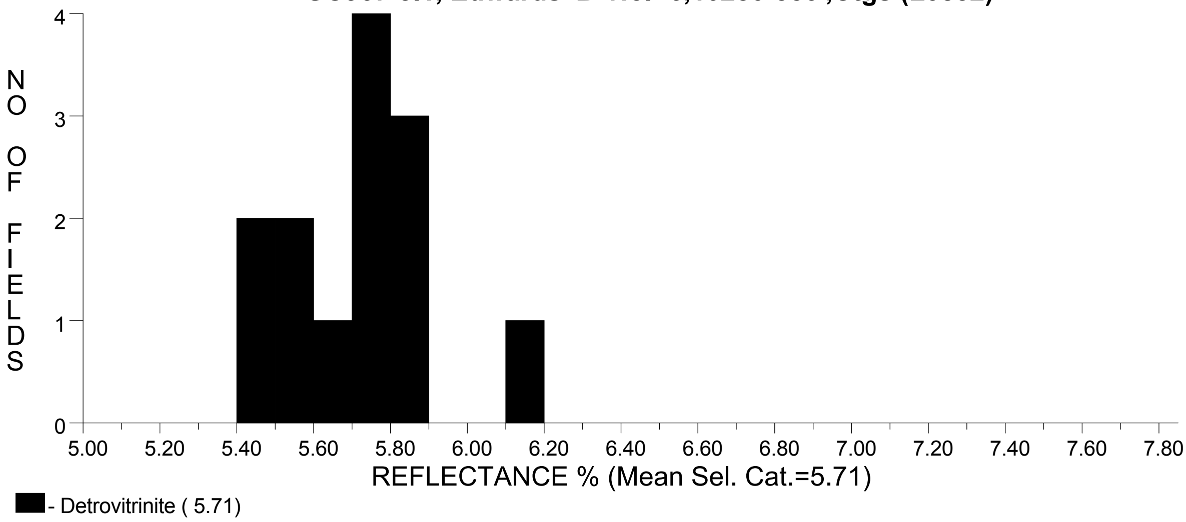
GC967-1.1, Edwards 'B' No 1-6, 9010-20', Ctgs (L0830)

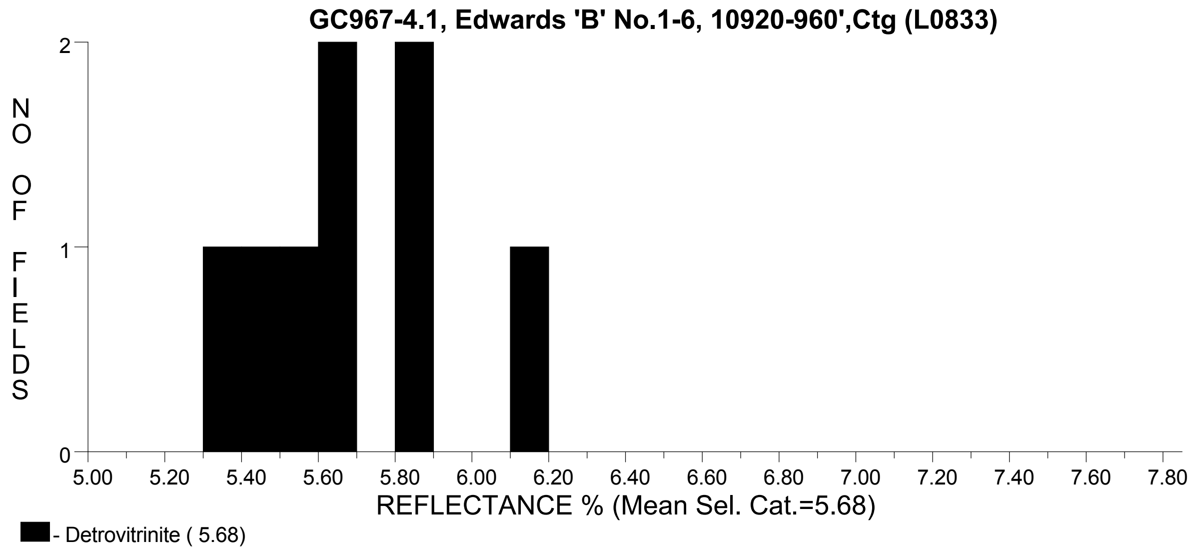


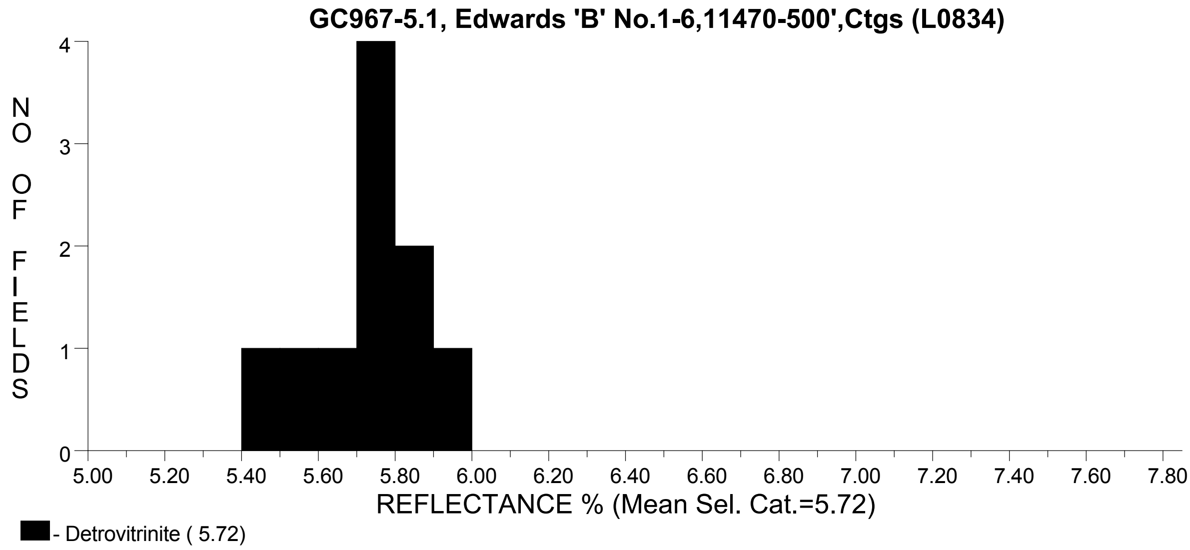
GC967-2.1, Edwards 'B' No. 1-6, 9440-50', Ctg (L0831)

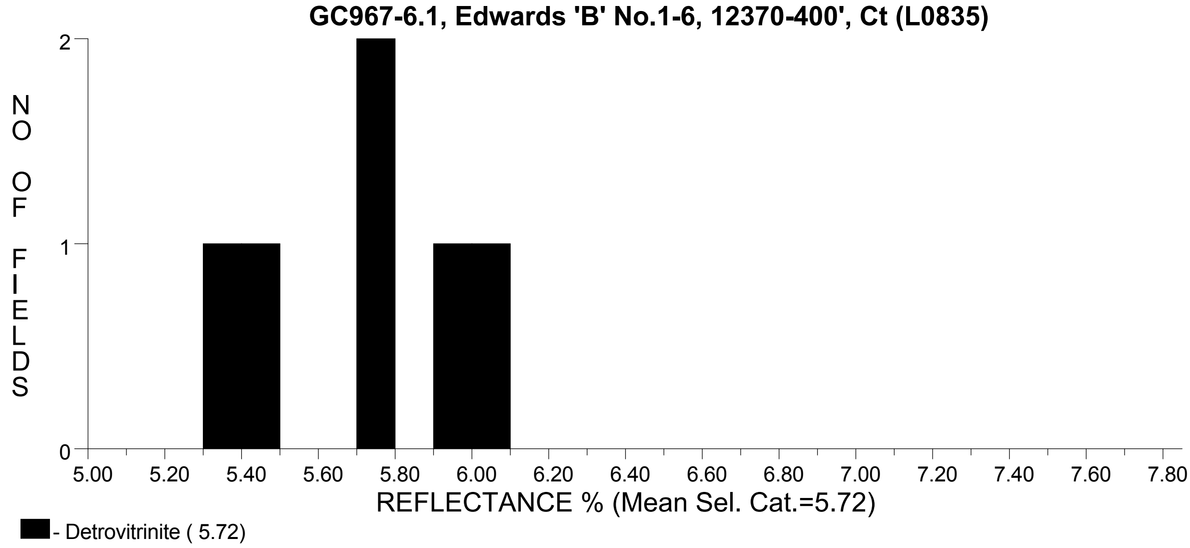


GC967-3.1, Edwards 'B' No. -6,10250-350',Ctgs (L0832)

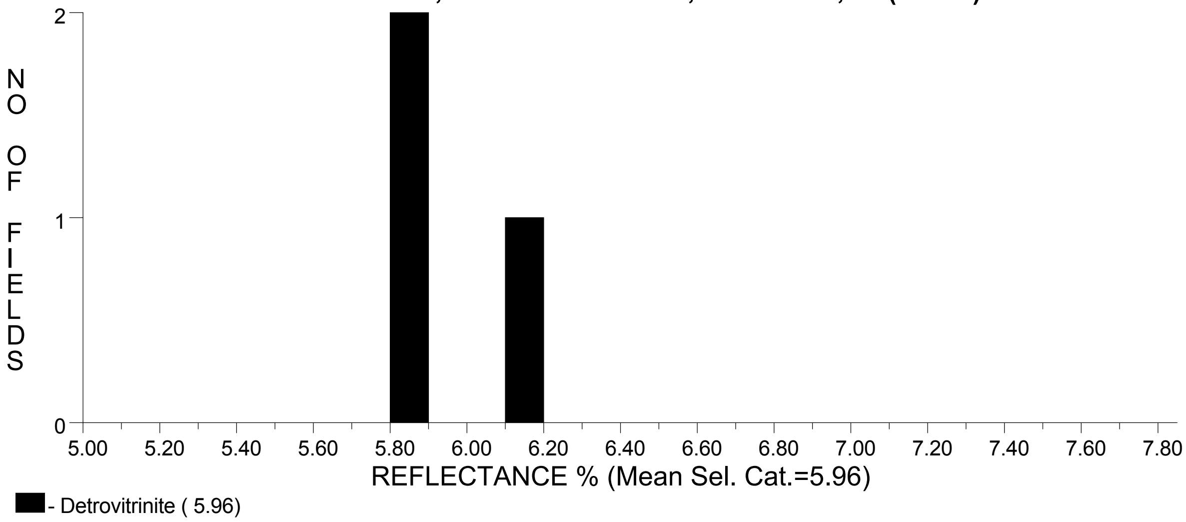



GC967-4.1, Edwards 'B' No.1-6, 10920-960',Ctg (L0833)
NO OF FIELDS
REFLECTANCE % (Mean Sel. Cat.=5.68)
- Detrovitrinite (5.68)

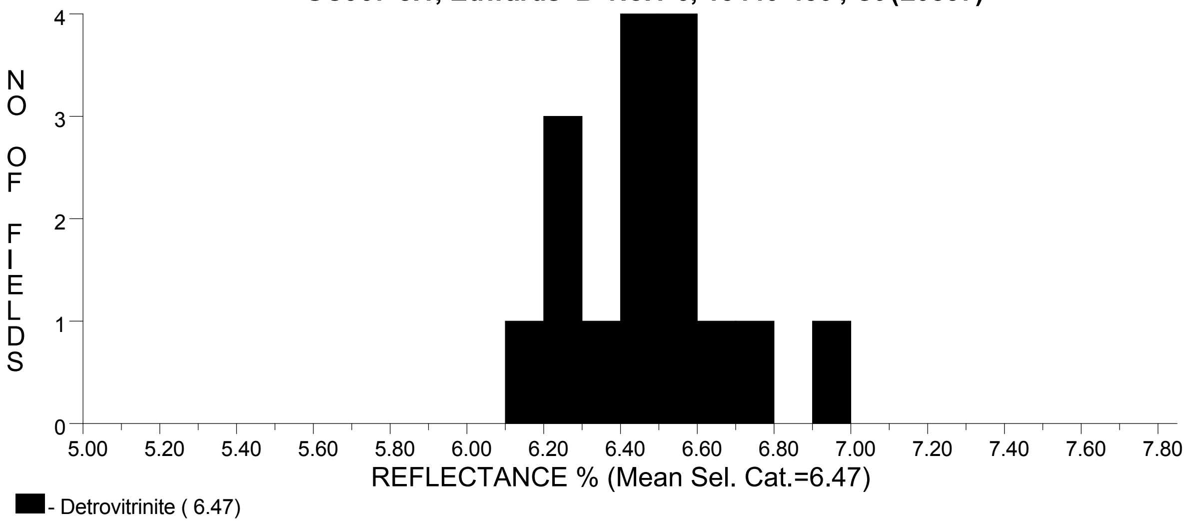

GC967-5.1, Edwards 'B' No.1-6,11470-500',Ctgs (L0834)
NO OF FIELDS
REFLECTANCE % (Mean Sel. Cat.=5.72)
- Detrovitrinite (5.72)


GC967-6.1, Edwards 'B' No.1-6, 12370-400', Ct (L0835)
NO OF FIELDS
REFLECTANCE % (Mean Sel. Cat.=5.72)
- Detrovitrinite (5.72)

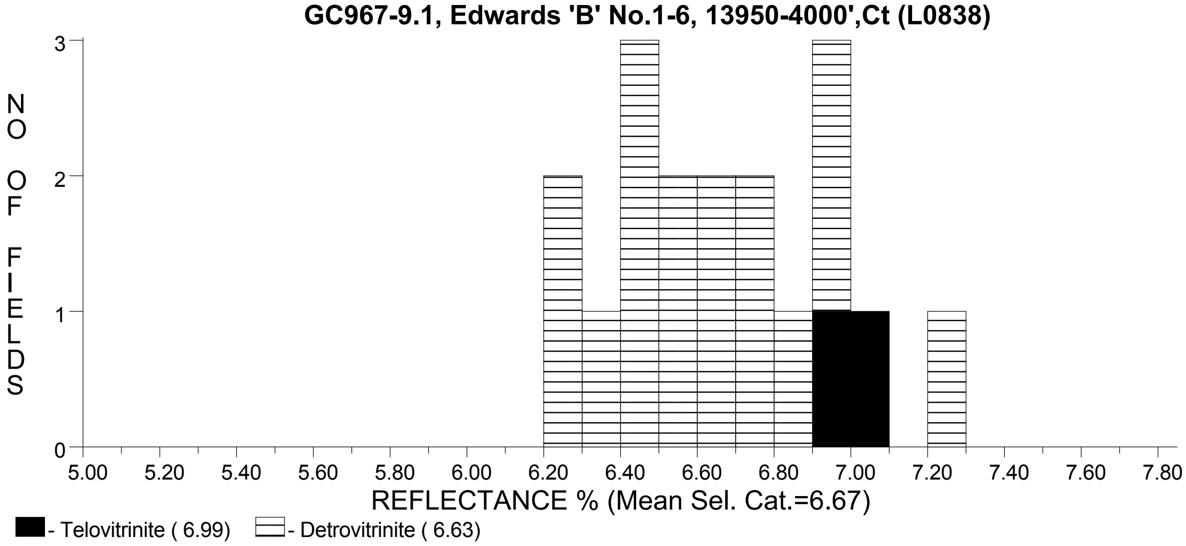
GC967-7.1, Edwards 'b' No.1-6, 12900-950', Ct (L0836)

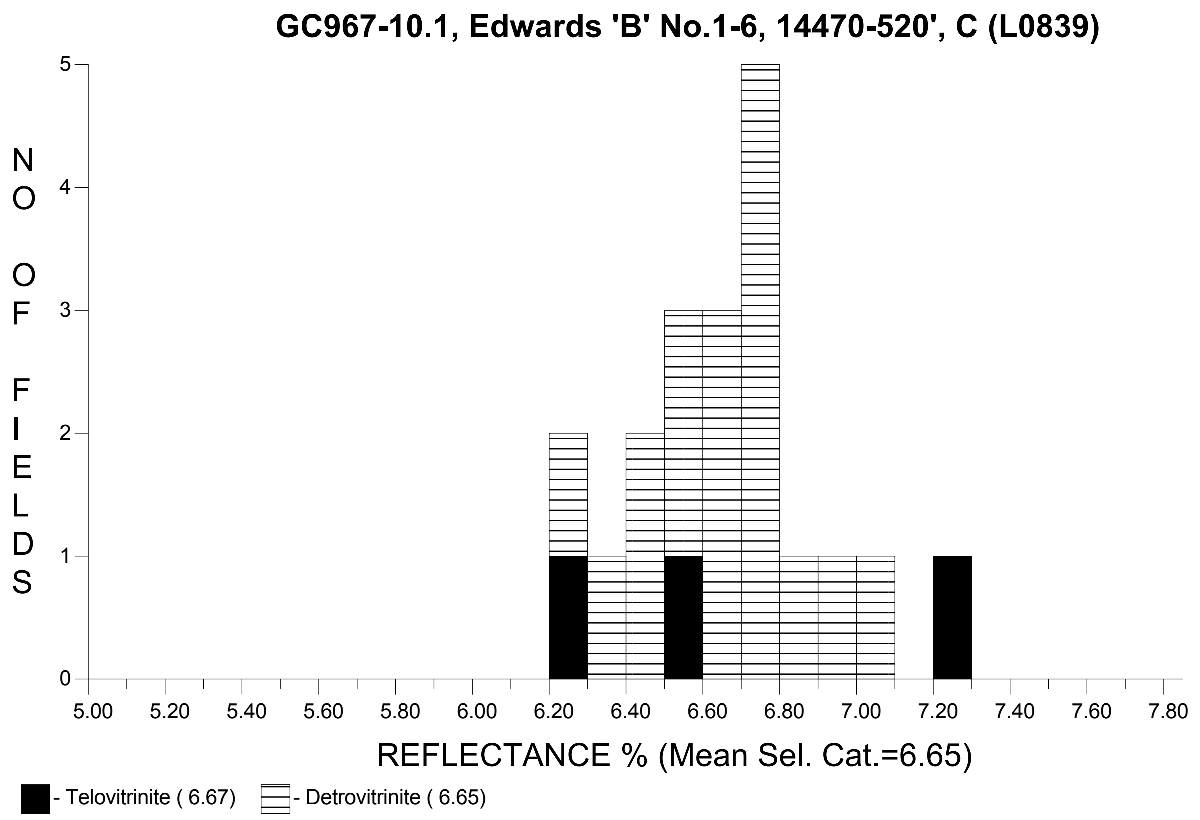


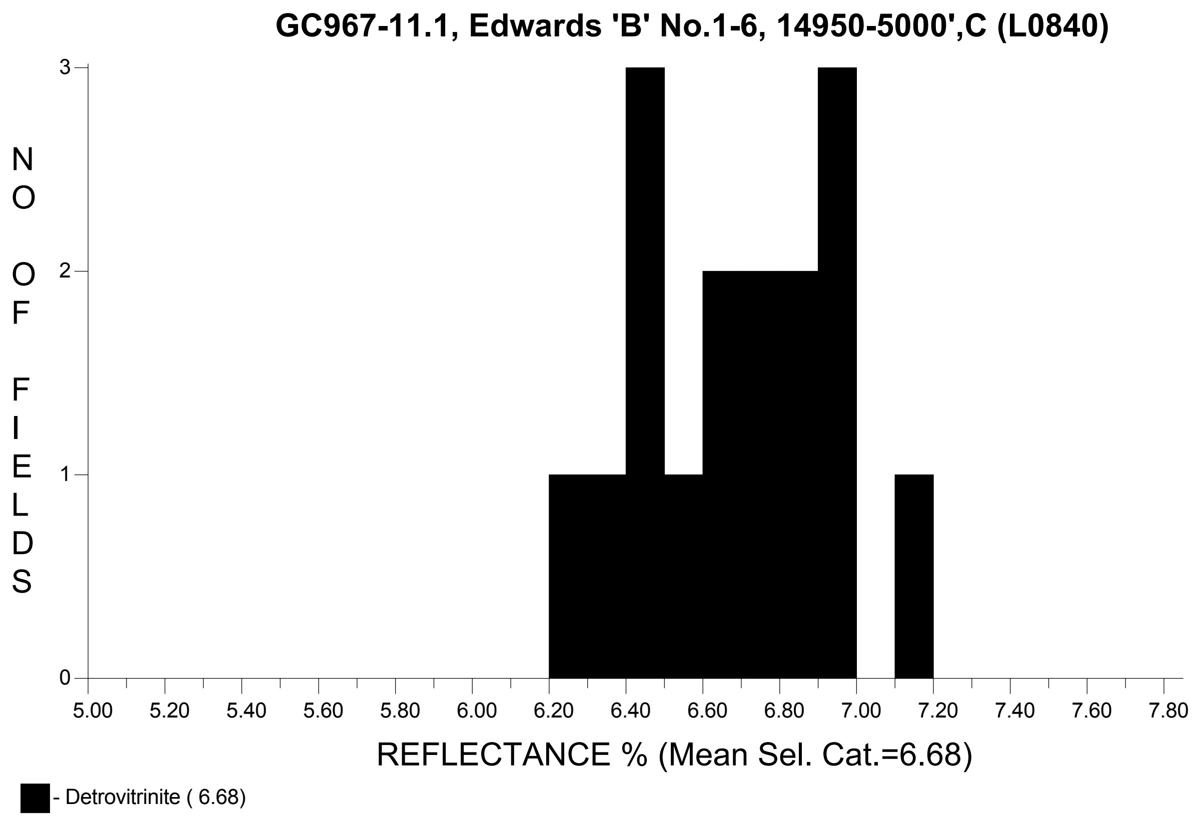
GC967-8.1, Edwards 'B' No.1-6, 13440-450', Ct (L0837)

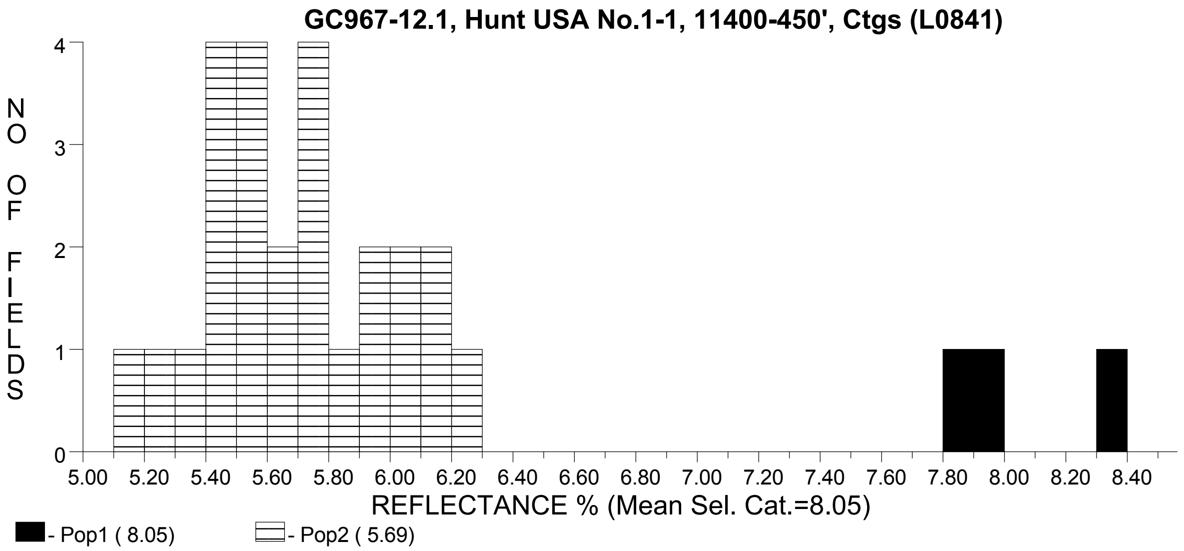


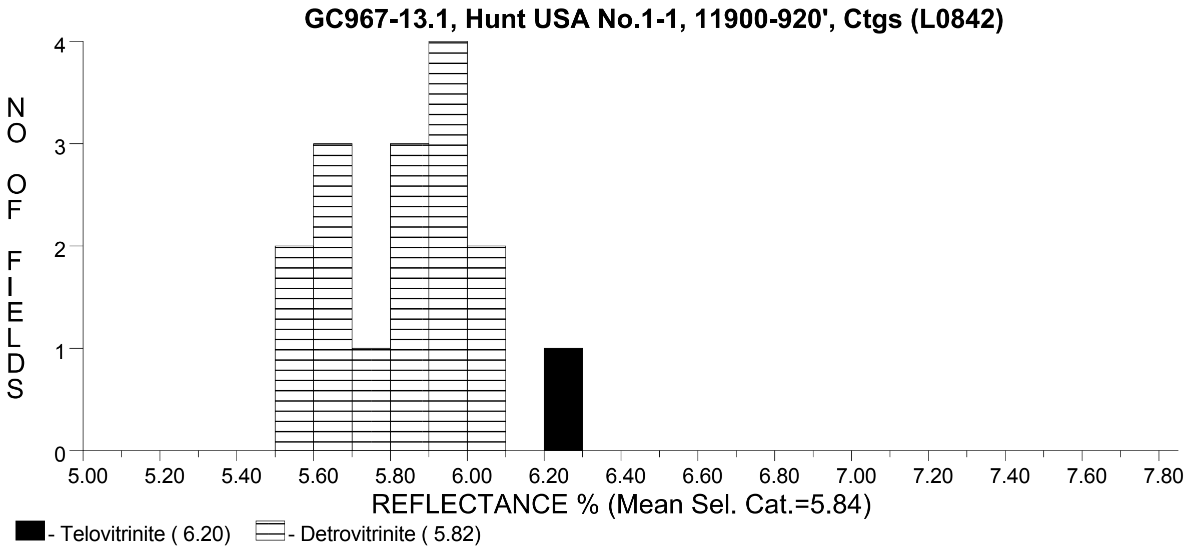
GC967-9.1, Edwards 'B' No.1-6, 13950-4000',Ct (L0838)

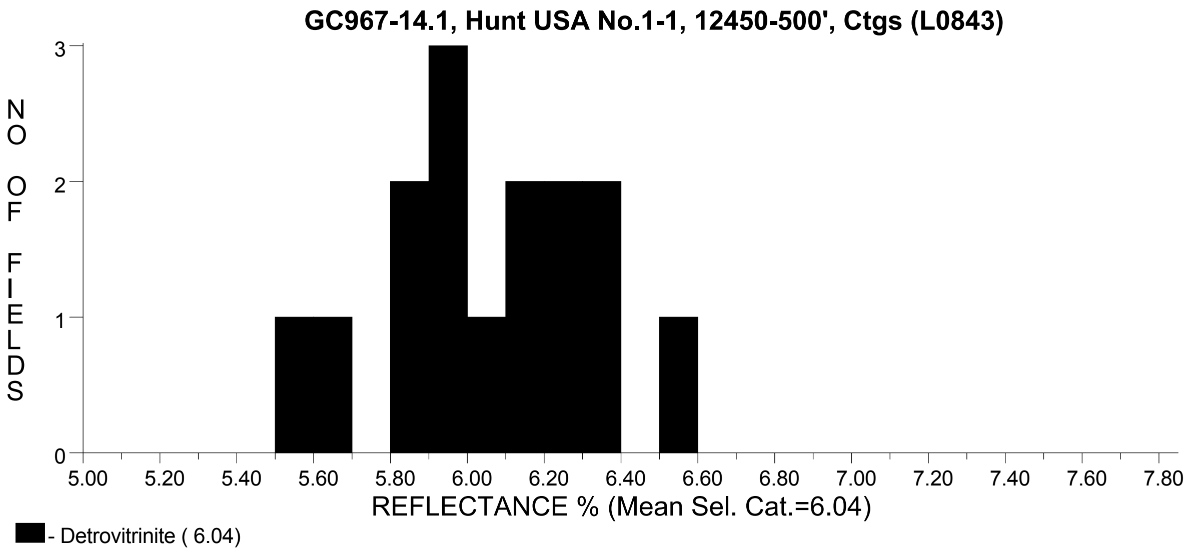


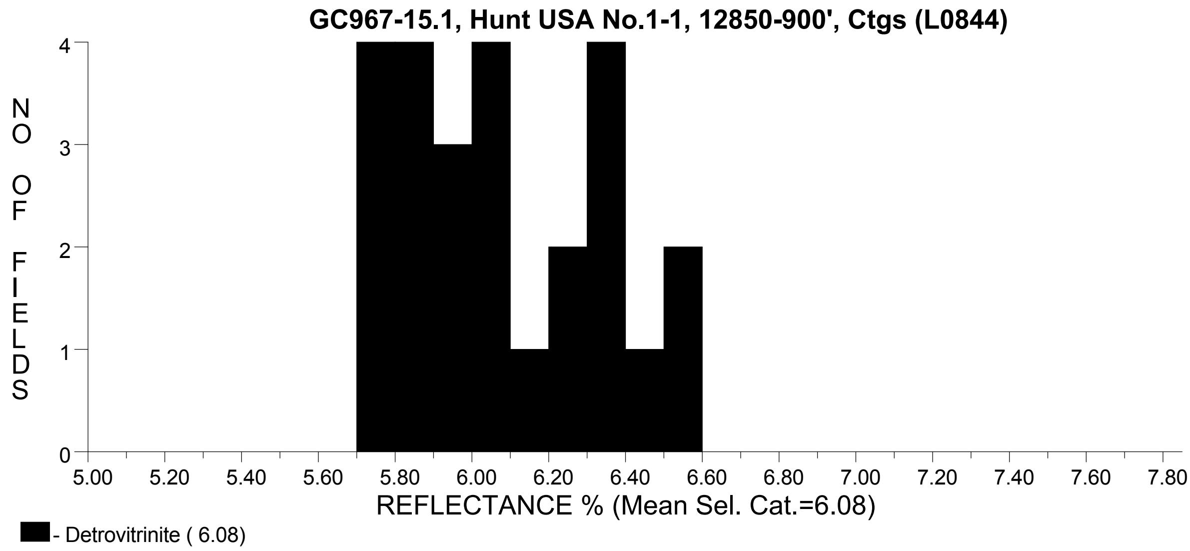

GC967-10.1, Edwards 'B' No.1-6, 14470-520', C (L0839)
NO OF FIELDS
0
1
2
3
4
5
5.00
5.20
5.40
5.60
5.80
6.00
6.20
6.40
6.60
6.80
7.00
7.20
7.40
7.60
7.80
REFLECTANCE % (Mean Sel. Cat.=6.65)
- Telovitrinite (6.67)
- Detrovitrinite (6.65)

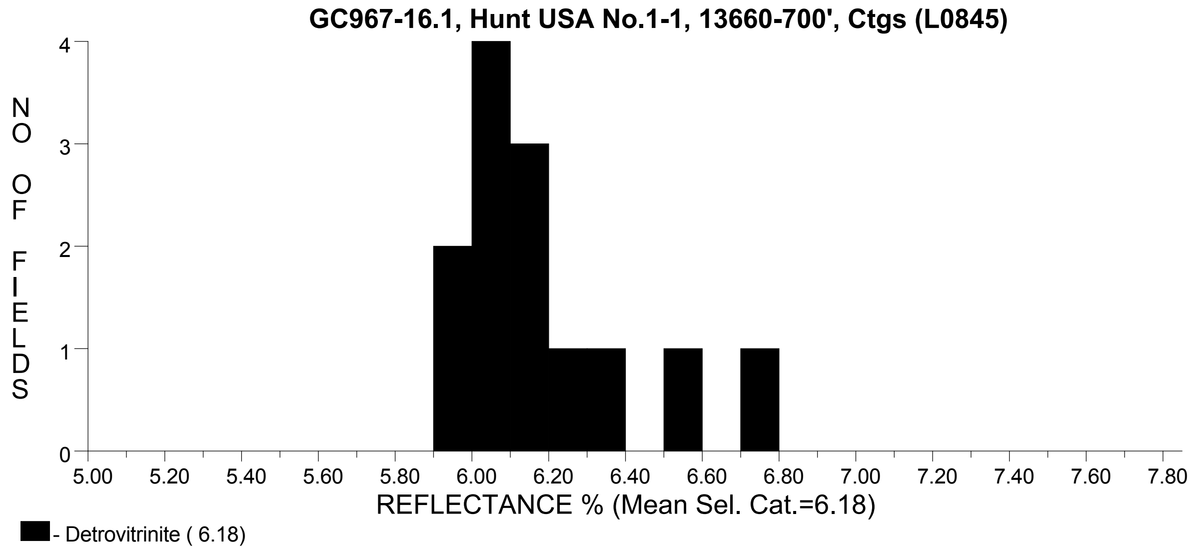

GC967-11.1, Edwards 'B' No.1-6, 14950-5000',C (L0840)
NO OF FIELDS
0
1
2
3
5.00
5.20
5.40
5.60
5.80
6.00
6.20
6.40
6.60
6.80
7.00
7.20
7.40
7.60
7.80
REFLECTANCE % (Mean Sel. Cat.=6.68)
- Detrovitrinite (6.68)

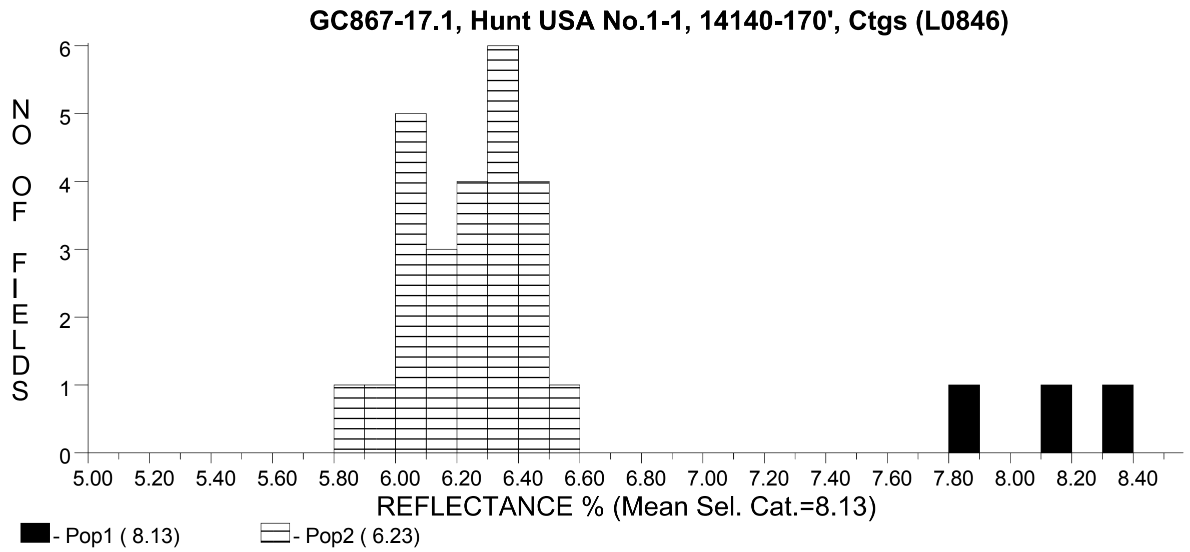

GC967-12.1, Hunt USA No.1-1, 11400-450', Ctgs (L0841)
NO OF FIELDS
0
1
2
3
4
5.00 5.20 5.40 5.60 5.80 6.00 6.20 6.40 6.60 6.80 7.00 7.20 7.40 7.60 7.80 8.00 8.20 8.40
REFLECTANCE % (Mean Sel. Cat.=8.05)
- Pop1 (8.05)
- Pop2 (5.69)


GC967-13.1, Hunt USA No.1-1, 11900-920', Ctgs (L0842)
NO OF FIELDS
0
1
2
3
4
5.00 5.20 5.40 5.60 5.80 6.00 6.20 6.40 6.60 6.80 7.00 7.20 7.40 7.60 7.80
REFLECTANCE % (Mean Sel. Cat.=5.84)
- Telovitrinite (6.20)
- Detrovitrinite (5.82)

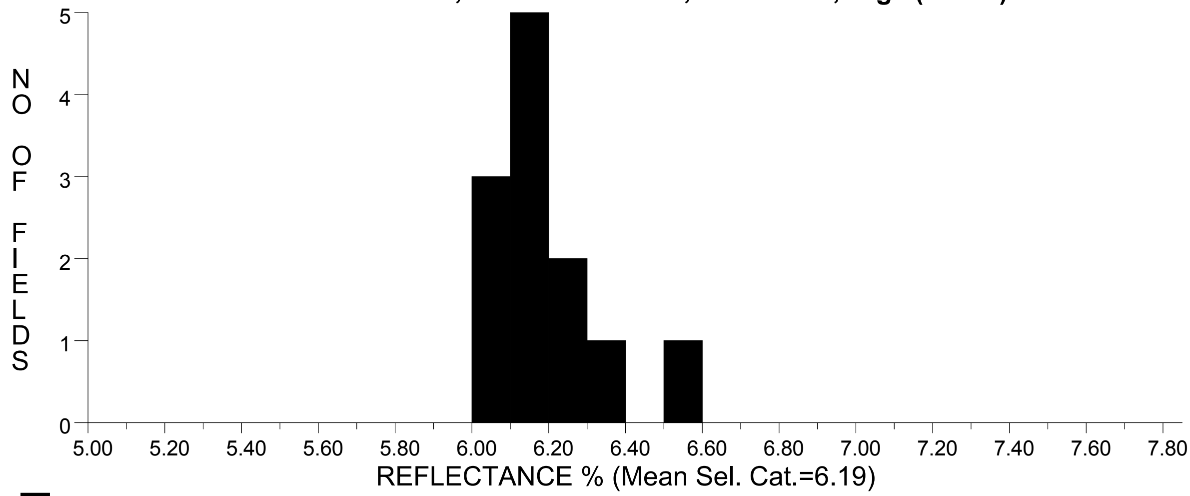

GC967-14.1, Hunt USA No.1-1, 12450-500', Ctgs (L0843)
NO OF FIELDS
0
1
2
3
5.00 5.20 5.40 5.60 5.80 6.00 6.20 6.40 6.60 6.80 7.00 7.20 7.40 7.60 7.80
REFLECTANCE % (Mean Sel. Cat.=6.04)
- Detrovitrinite (6.04)


GC967-15.1, Hunt USA No.1-1, 12850-900', Ctgs (L0844)
NO OF FIELDS
0
1
2
3
4
5.00 5.20 5.40 5.60 5.80 6.00 6.20 6.40 6.60 6.80 7.00 7.20 7.40 7.60 7.80
REFLECTANCE % (Mean Sel. Cat.=6.08)
- Detrovitrinite (6.08)


GC967-16.1, Hunt USA No.1-1, 13660-700', Ctgs (L0845)
NO OF FIELDS
0
1
2
3
4
5.00 5.20 5.40 5.60 5.80 6.00 6.20 6.40 6.60 6.80 7.00 7.20 7.40 7.60 7.80
REFLECTANCE % (Mean Sel. Cat.=6.18)
- Detrovitrinite (6.18)

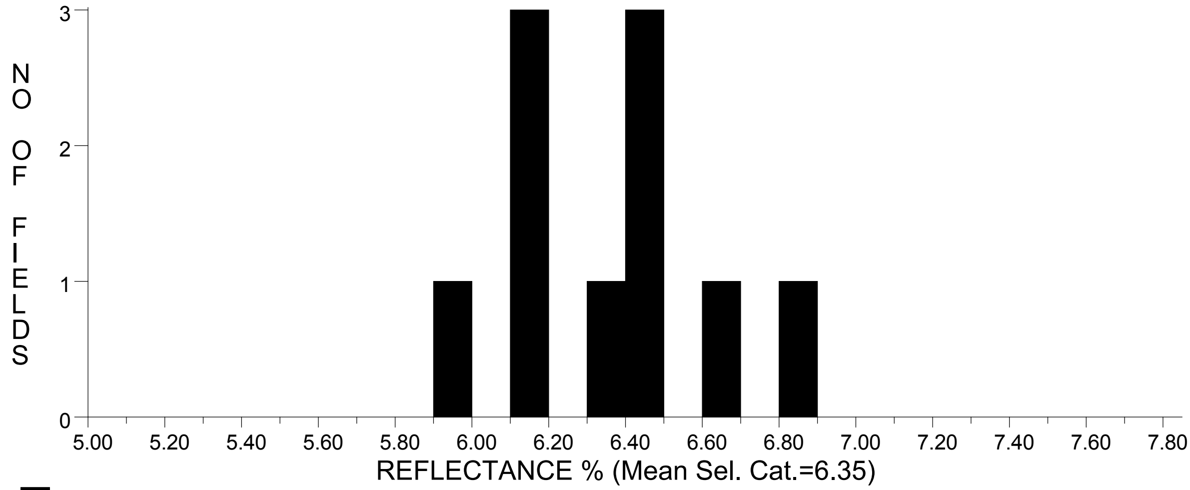

GC867-17.1, Hunt USA No.1-1, 14140-170', Ctgs (L0846)
NO OF FIELDS
0
1
2
3
4
5
6
5.00 5.20 5.40 5.60 5.80 6.00 6.20 6.40 6.60 6.80 7.00 7.20 7.40 7.60 7.80 8.00 8.20 8.40
REFLECTANCE % (Mean Sel. Cat.=8.13)
- Pop1 (8.13)
- Pop2 (6.23)

GC967-18.1, Hunt USA No.1-1, 14610-630', Ctgs (L0847)



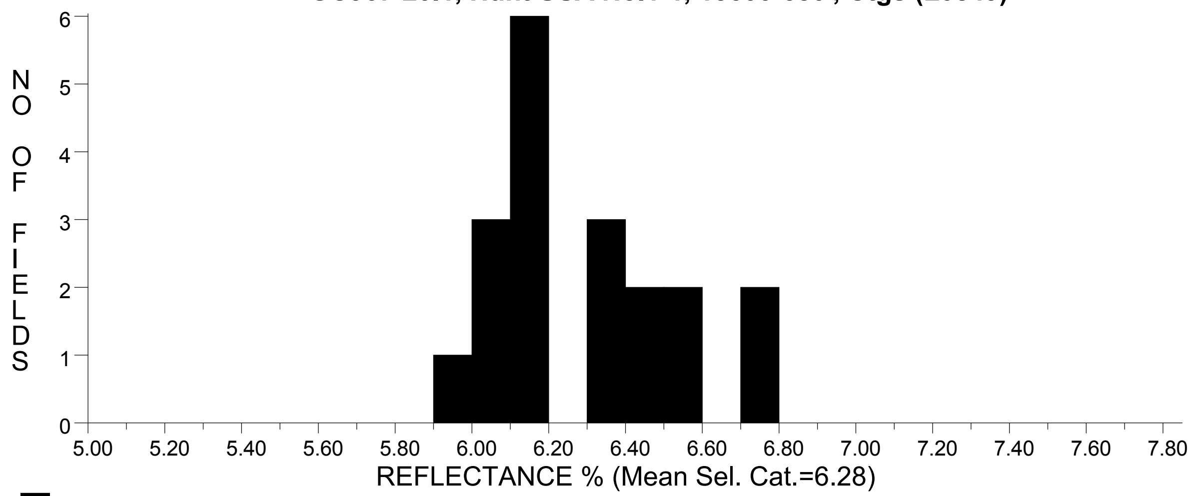
- Detrovitrinite (6.19)

GC967-19.1, Hunt USA No.1-1, 15050-110', Ctgs (L0848)

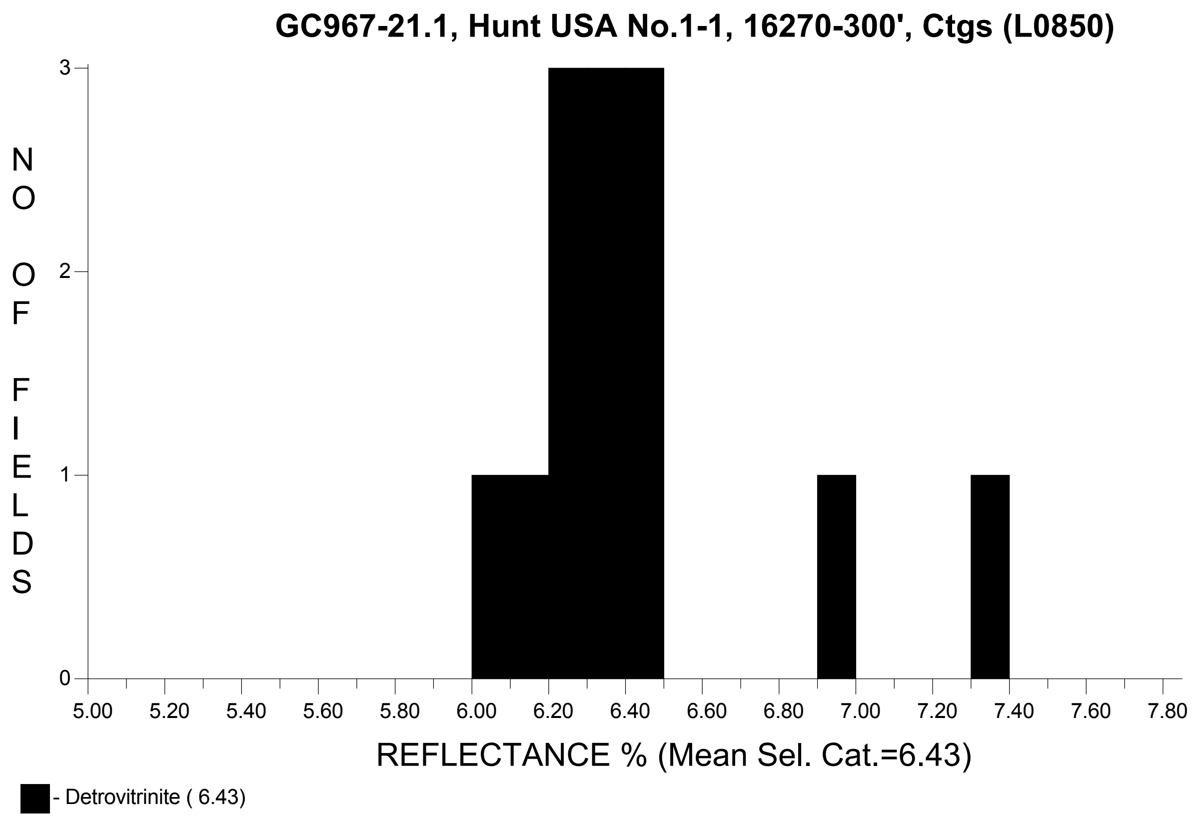


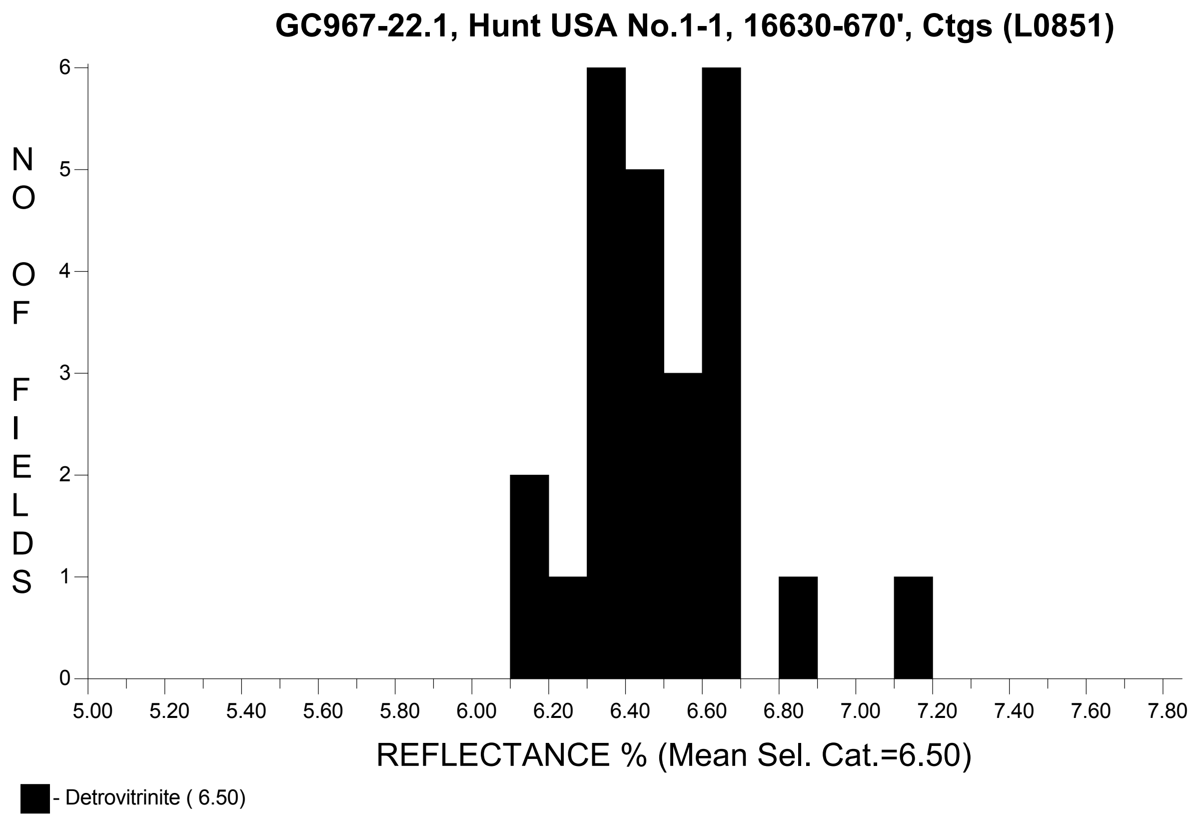
- Detrovitrinite (6.35)

GC967-20.1, Hunt USA No.1-1, 15600-650', Ctgs (L0849)



- Detrovitrinite (6.28)


GC967-21.1, Hunt USA No.1-1, 16270-300', Ctgs (L0850)
NO OF FIELDS
0
1
2
3
5.00 5.20 5.40 5.60 5.80 6.00 6.20 6.40 6.60 6.80 7.00 7.20 7.40 7.60 7.80
REFLECTANCE % (Mean Sel. Cat.=6.43)
- Detrovitrinite (6.43)


GC967-22.1, Hunt USA No.1-1, 16630-670', Ctgs (L0851)
NO OF FIELDS
0
1
2
3
4
5
6
5.00 5.20 5.40 5.60 5.80 6.00 6.20 6.40 6.60 6.80 7.00 7.20 7.40 7.60 7.80
REFLECTANCE % (Mean Sel. Cat.=6.50)
- Detrovitrinite (6.50)

R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range
4.60			4.90			5.20			5.50			5.80			6.10			6.40			6.70			7.00		
4.61			4.91			5.21			5.51			5.81			6.11			6.41			6.71			7.01		
4.62			4.92			5.22			5.52			5.82			6.12			6.42			6.72			7.02		
4.63			4.93			5.23			5.53			5.83			6.13			6.43			6.73			7.03		
4.64			4.94			5.24			5.54	1		5.84			6.14			6.44			6.74			7.04		
4.65			4.95			5.25			5.55			5.85			6.15			6.45			6.75			7.05		
4.66			4.96			5.26			5.56			5.86	1		6.16			6.46			6.76			7.06		
4.67			4.97			5.27			5.57	1		5.87			6.17			6.47			6.77			7.07		
4.68			4.98			5.28			5.58	1		5.88		FGV	6.18			6.48			6.78			7.08		
4.69			4.99			5.29			5.59			5.89	1	↓	6.19			6.49			6.79			7.09		
4.70			5.00			5.30			5.60			5.90			6.20			6.50			6.80			7.10		
4.71			5.01			5.31			5.61			5.91			6.21			6.51			6.81			7.11		
4.72			5.02			5.32			5.62			5.92			6.22			6.52			6.82			7.12		
4.73			5.03			5.33			5.63			5.93			6.23			6.53			6.83			7.13		
4.74			5.04			5.34			5.64			5.94			6.24			6.54			6.84			7.14		
4.75			5.05			5.35			5.65			5.95			6.25			6.55			6.85			7.15		
4.76			5.06			5.36			5.66			5.96			6.26			6.56			6.86			7.16		
4.77			5.07			5.37			5.67			5.97			6.27			6.57			6.87			7.17		
4.78			5.08			5.38			5.68			5.98			6.28			6.58			6.88			7.18		
4.79			5.09			5.39			5.69			5.99			6.29			6.59			6.89			7.19		
4.80			5.10			5.40			5.70			6.00			6.30			6.60			6.90			7.20		
4.81			5.11			5.41			5.71			6.01			6.31			6.61			6.91			7.21		
4.82			5.12			5.42			5.72			6.02			6.32			6.62			6.92			7.22		
4.83			5.13	1	↑	5.43			5.73	1		6.03			6.33			6.63			6.93			7.23		
4.84			5.14		FGV	5.44			5.74			6.04			6.34			6.64			6.94			7.24		
4.85			5.15			5.45			5.75			6.05			6.35			6.65			6.95			7.25		
4.86			5.16			5.46	1		5.76	1		6.06			6.36			6.66			6.96			7.26		
4.87			5.17			5.47			5.77			6.07			6.37			6.67			6.97			7.27		
4.88			5.18			5.48			5.78			6.08			6.38			6.68			6.98			7.28		
4.89			5.19			5.49			5.79			6.09			6.39			6.69			6.99			7.29		

VITRINITE <0.1%		INERTINITE <0.1%						LIPTINITE -%								OIL DROPS	BITUMEN
TV	DV	Sfus	Scler	Fus	Macr	ID	Micr	Spor	Cut	Sub	Res	Ld	Bituminite	Telalginite	Lamalginite	Oil cut	

Sample Number..L0830...Well Name...South Western,...Edwards ‘B’ No. 1-6,..GC967-1.1.. Depth.....9010-9020Ft..... .... SampleType....Ctgs...
Date. ..11/.06/ 2006.. Op..SPR........ FGV - First Generation Vitrinite, RV - Reworked Vitrinite, BTT - Bituminite, B - Bitumen, Inert - Inertinite, Cav - Cavings, DA - Drilling Mud Additives MICR D:\RWORK.ms6\967VRW06.doc

R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range
4.60			4.90			5.20			5.50	1		5.80	2		6.10			6.40			6.70			7.00		
4.61			4.91			5.21			5.51			5.81			6.11			6.41			6.71			7.01		
4.62			4.92			5.22			5.52			5.82			6.12			6.42			6.72			7.02		
4.63			4.93			5.23			5.53	2		5.83	1		6.13			6.43			6.73			7.03		
4.64			4.94			5.24			5.54			5.84	3		6.14			6.44			6.74			7.04		
4.65			4.95			5.25			5.55			5.85			6.15			6.45			6.75			7.05		
4.66			4.96			5.26	1	↑	5.56			5.86	1		6.16			6.46			6.76			7.06		
4.67			4.97			5.27		FGV	5.57			5.87	2		6.17			6.47			6.77			7.07		
4.68			4.98			5.28			5.58	2		5.88			6.18			6.48			6.78			7.08		
4.69			4.99			5.29			5.59			5.89			6.19			6.49			6.79			7.09		
4.70			5.00			5.30			5.60			5.90			6.20			6.50			6.80			7.10		
4.71			5.01			5.31			5.61	1		5.91			6.21			6.51			6.81			7.11		
4.72			5.02			5.32			5.62			5.92			6.22			6.52			6.82			7.12		
4.73			5.03			5.33			5.63			5.93			6.23			6.53			6.83			7.13		
4.74			5.04			5.34	1		5.64			5.94	1		6.24			6.54			6.84			7.14		
4.75			5.05			5.35			5.65			5.95			6.25			6.55			6.85			7.15		
4.76			5.06			5.36			5.66			5.96			6.26			6.56			6.86			7.16		
4.77			5.07			5.37			5.67			5.97			6.27			6.57			6.87			7.17		
4.78			5.08			5.38			5.68			5.98			6.28			6.58			6.88			7.18		
4.79			5.09			5.39	1		5.69	1		5.99			6.29			6.59			6.89			7.19		
4.80			5.10			5.40			5.70	2		6.00			6.30			6.60			6.90			7.20		
4.81			5.11			5.41			5.71			6.01			6.31			6.61			6.91			7.21		
4.82			5.12			5.42			5.72			6.02			6.32			6.62			6.92			7.22		
4.83			5.13			5.43			5.73			6.03			6.33			6.63			6.93			7.23		
4.84			5.14			5.44	1		5.74			6.04			6.34			6.64			6.94			7.24		
4.85			5.15			5.45			5.75			6.05			6.35			6.65			6.95			7.25		
4.86			5.16			5.46			5.76			6.06	1	FGV	6.36			6.66			6.96			7.26		
4.87			5.17			5.47			5.77			6.07	1	↓	6.37			6.67			6.97			7.27		
4.88			5.18			5.48			5.78			6.08			6.38			6.68			6.98			7.28		
4.89			5.19			5.49			5.79			6.09			6.39			6.69			6.99			7.29		

VITRINITE 0.6 %		INERTINITE 0.1%						LIPTINITE -%								OIL DROPS	BITUMEN
TV	DV	Sfus	Scler	Fus	Macr	ID	Micr	Spor	Cut	Sub	Res	Ld	Bituminite	Telalginite	Lamalginite	Oil cut	

Sample Number..L0831...Well Name...South Western,...Edwards 'B' No. 1-6.....GC967-2.1.................................... Depth.....9440-9450Ft..... .... SampleType....Ctgs...
Date. ..11/.06/ 2006.. Op..SPR........ FGV - First Generation Vitrinite, RV - Reworked Vitrinite, BTT - Bituminite, B - Bitumen, Inert - Inertinite, Cav - Cavings, DA - Drilling Mud Additives MICR D:\RWORK.ms6\967VRW06.doc

R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range
4.60			4.90			5.20			5.50			5.80			6.10			6.40			6.70			7.00		
4.61			4.91			5.21			5.51			5.81	1		6.11			6.41			6.71			7.01		
4.62			4.92			5.22			5.52			5.82			6.12			6.42			6.72			7.02		
4.63			4.93			5.23			5.53	1		5.83			6.13			6.43			6.73			7.03		
4.64			4.94			5.24			5.54			5.84			6.14			6.44			6.74			7.04		
4.65			4.95			5.25			5.55			5.85	1		6.15		FGV	6.45			6.75			7.05		
4.66			4.96			5.26			5.56			5.86			6.16	1	↓	6.46			6.76			7.06		
4.67			4.97			5.27			5.57			5.87			6.17			6.47			6.77			7.07		
4.68			4.98			5.28			5.58	1		5.88	1		6.18			6.48			6.78			7.08		
4.69			4.99			5.29			5.59			5.89			6.19			6.49			6.79			7.09		
4.70			5.00			5.30			5.60			5.90			6.20			6.50			6.80			7.10		
4.71			5.01			5.31			5.61			5.91			6.21			6.51			6.81			7.11		
4.72			5.02			5.32			5.62			5.92			6.22			6.52			6.82			7.12		
4.73			5.03			5.33			5.63			5.93			6.23			6.53			6.83			7.13		
4.74			5.04			5.34			5.64			5.94			6.24			6.54			6.84			7.14		
4.75			5.05			5.35			5.65			5.95			6.25			6.55			6.85			7.15		
4.76			5.06			5.36			5.66			5.96			6.26			6.56			6.86			7.16		
4.77			5.07			5.37			5.67			5.97			6.27			6.57			6.87			7.17		
4.78			5.08			5.38			5.68	1		5.98			6.28			6.58			6.88			7.18		
4.79			5.09			5.39			5.69			5.99			6.29			6.59			6.89			7.19		
4.80			5.10			5.40			5.70	1		6.00			6.30			6.60			6.90			7.20		
4.81			5.11			5.41			5.71	1		6.01			6.31			6.61			6.91			7.21		
4.82			5.12			5.42	1	↑	5.72	1		6.02			6.32			6.62			6.92			7.22		
4.83			5.13			5.43		FGV	5.73			6.03			6.33			6.63			6.93			7.23		
4.84			5.14			5.44	1		5.74			6.04			6.34			6.64			6.94			7.24		
4.85			5.15			5.45			5.75			6.05			6.35			6.65			6.95			7.25		
4.86			5.16			5.46			5.76			6.06			6.36			6.66			6.96			7.26		
4.87			5.17			5.47			5.77			6.07			6.37			6.67			6.97			7.27		
4.88			5.18			5.48			5.78			6.08			6.38			6.68			6.98			7.28		
4.89			5.19			5.49			5.79	1		6.09			6.39			6.69			6.99			7.29		

VITRINITE 0.3%		INERTINITE <0.1%						LIPTINITE -%								OIL DROPS	BITUMEN
TV	DV	Sfus	Scler	Fus	Macr	ID	Micr	Spor	Cut	Sub	Res	Ld	Bituminite	Telalginite	Lamalginite	Oil	cut

Sample Number..L0832...Well Name...South Western,...Edwards 'B' No. 1-6., GC967-3.1.. Depth..10250-10350Ft..... .... SampleType....Ctgs...
Date. ..11/.06/ 2006.. Op..SPR........ FGV - First Generation Vitrinite, RV - Reworked Vitrinite, BTT - Bituminite, B - Bitumen, Inert - Inertinite, Cav - Cavings, DA - Drilling Mud Additives

R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range
4.60			4.90			5.20			5.50			5.80			6.10			6.40			6.70			7.00		
4.61			4.91			5.21			5.51			5.81	1		6.11			6.41			6.71			7.01		
4.62			4.92			5.22			5.52			5.82			6.12		FGV	6.42			6.72			7.02		
4.63			4.93			5.23			5.53	1		5.83			6.13	1	↓	6.43			6.73			7.03		
4.64			4.94			5.24			5.54			5.84			6.14			6.44			6.74			7.04		
4.65			4.95			5.25			5.55			5.85			6.15			6.45			6.75			7.05		
4.66			4.96			5.26			5.56			5.86			6.16			6.46			6.76			7.06		
4.67			4.97			5.27			5.57			5.87			6.17			6.47			6.77			7.07		
4.68			4.98			5.28			5.58			5.88			6.18			6.48			6.78			7.08		
4.69			4.99			5.29			5.59			5.89	1		6.19			6.49			6.79			7.09		
4.70			5.00			5.30			5.60	1		5.90			6.20			6.50			6.80			7.10		
4.71			5.01			5.31			5.61			5.91			6.21			6.51			6.81			7.11		
4.72			5.02			5.32			5.62			5.92			6.22			6.52			6.82			7.12		
4.73			5.03			5.33			5.63			5.93			6.23			6.53			6.83			7.13		
4.74			5.04			5.34			5.64			5.94			6.24			6.54			6.84			7.14		
4.75			5.05			5.35			5.65			5.95			6.25			6.55			6.85			7.15		
4.76			5.06			5.36	1	↑	5.66			5.96			6.26			6.56			6.86			7.16		
4.77			5.07			5.37		FGV	5.67			5.97			6.27			6.57			6.87			7.17		
4.78			5.08			5.38			5.68			5.98			6.28			6.58			6.88			7.18		
4.79			5.09			5.39			5.69	1		5.99			6.29			6.59			6.89			7.19		
4.80			5.10			5.40			5.70			6.00			6.30			6.60			6.90			7.20		
4.81			5.11			5.41	1		5.71			6.01			6.31			6.61			6.91			7.21		
4.82			5.12			5.42			5.72			6.02			6.32			6.62			6.92			7.22		
4.83			5.13			5.43			5.73			6.03			6.33			6.63			6.93			7.23		
4.84			5.14			5.44			5.74			6.04			6.34			6.64			6.94			7.24		
4.85			5.15			5.45			5.75			6.05			6.35			6.65			6.95			7.25		
4.86			5.16			5.46			5.76			6.06			6.36			6.66			6.96			7.26		
4.87			5.17			5.47			5.77			6.07			6.37			6.67			6.97			7.27		
4.88			5.18			5.48			5.78			6.08			6.38			6.68			6.98			7.28		
4.89			5.19			5.49			5.79			6.09			6.39			6.69			6.99			7.29		

VITRINITE <0.1%		INERTINITE <0.1%						LIPTINITE -%								OIL DROPS	BITUMEN
TV	DV	Sfus	Scler	Fus	Macr	ID	Micr	Spor	Cut	Sub	Res	Ld	Bituminite	Telalginite	Lamalginite	Oil	cut

Sample Number..L0833...Well Name...South Western,...Edwards ‘B’ No. 1-6,....GC967-4.1....................................... Depth.....9010-9020Ft..... .... SampleType....Ctgs...
Date. ..11/.06/ 2006.. Op..SPR........ FGV - First Generation Vitrinite, RV - Reworked Vitrinite, BTT - Bituminite, B - Bitumen, Inert - Inertinite, Cav - Cavings, DA - Drilling Mud Additives MICR D:\RWORK.ms6\967VRW06.doc

R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range
4.60			4.90			5.20			5.50	1		5.80			6.10			6.40			6.70			7.00		
4.61			4.91			5.21			5.51			5.81			6.11			6.41			6.71			7.01		
4.62			4.92			5.22			5.52			5.82			6.12			6.42			6.72			7.02		
4.63			4.93			5.23			5.53			5.83			6.13			6.43			6.73			7.03		
4.64			4.94			5.24			5.54			5.84			6.14			6.44			6.74			7.04		
4.65			4.95			5.25			5.55			5.85	1		6.15			6.45			6.75			7.05		
4.66			4.96			5.26			5.56			5.86			6.16			6.46			6.76			7.06		
4.67			4.97			5.27			5.57			5.87			6.17			6.47			6.77			7.07		
4.68			4.98			5.28			5.58			5.88	1		6.18			6.48			6.78			7.08		
4.69			4.99			5.29			5.59			5.89		FGV	6.19			6.49			6.79			7.09		
4.70			5.00			5.30			5.60	1		5.90	1	↓	6.20			6.50			6.80			7.10		
4.71			5.01			5.31			5.61			5.91			6.21			6.51			6.81			7.11		
4.72			5.02			5.32			5.62			5.92			6.22			6.52			6.82			7.12		
4.73			5.03			5.33			5.63			5.93			6.23			6.53			6.83			7.13		
4.74			5.04			5.34			5.64			5.94			6.24			6.54			6.84			7.14		
4.75			5.05			5.35			5.65			5.95			6.25			6.55			6.85			7.15		
4.76			5.06			5.36			5.66			5.96			6.26			6.56			6.86			7.16		
4.77			5.07			5.37			5.67			5.97			6.27			6.57			6.87			7.17		
4.78			5.08			5.38			5.68			5.98			6.28			6.58			6.88			7.18		
4.79			5.09			5.39			5.69			5.99			6.29			6.59			6.89			7.19		
4.80			5.10			5.40			5.70			6.00			6.30			6.60			6.90			7.20		
4.81			5.11			5.41			5.71			6.01			6.31			6.61			6.91			7.21		
4.82			5.12			5.42			5.72			6.02			6.32			6.62			6.92			7.22		
4.83			5.13			5.43			5.73	1		6.03			6.33			6.63			6.93			7.23		
4.84			5.14			5.44			5.74			6.04			6.34			6.64			6.94			7.24		
4.85			5.15			5.45			5.75			6.05			6.35			6.65			6.95			7.25		
4.86			5.16			5.46			5.76	2		6.06			6.36			6.66			6.96			7.26		
4.87			5.17			5.47	1	↑	5.77			6.07			6.37			6.67			6.97			7.27		
4.88			5.18			5.48		FGV	5.78	1		6.08			6.38			6.68			6.98			7.28		
4.89			5.19			5.49			5.79			6.09			6.39			6.69			6.99			7.29		

VITRINITE <0.1%		INERTINITE <0.1%						LIPTINITE -%								OIL DROPS	BITUMEN
TV	DV	Sfus	Scler	Fus	Macr	ID	Micr	Spor	Cut	Sub	Res	Ld	Bituminite	Telalginite	Lamalginite	Oil	cut

Sample Number..L0834...Well Name...South Western,...Edwards 'B' No. 1-6,....GC967-5.1....................................... Depth.....11470-11500Ft..... .... SampleType....Ctgs...

Date. ..11/.06/ 2006.. Op..SPR........ FGV - First Generation Vitrinite, RV - Reworked Vitrinite, BTT - Bituminite, B - Bitumen, Inert - Inertinite, Cav - Cavings, DA - Drilling Mud Additives

R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range
4.60			4.90			5.20			5.50			5.80			6.10			6.40			6.70			7.00		
4.61			4.91			5.21			5.51			5.81			6.11			6.41			6.71			7.01		
4.62			4.92			5.22			5.52			5.82			6.12			6.42			6.72			7.02		
4.63			4.93			5.23			5.53			5.83			6.13			6.43			6.73			7.03		
4.64			4.94			5.24			5.54			5.84			6.14			6.44			6.74			7.04		
4.65			4.95			5.25			5.55			5.85			6.15			6.45			6.75			7.05		
4.66			4.96			5.26			5.56			5.86			6.16			6.46			6.76			7.06		
4.67			4.97			5.27			5.57			5.87			6.17			6.47			6.77			7.07		
4.68			4.98			5.28			5.58			5.88			6.18			6.48			6.78			7.08		
4.69			4.99			5.29			5.59			5.89			6.19			6.49			6.79			7.09		
4.70			5.00			5.30			5.60			5.90			6.20			6.50			6.80			7.10		
4.71			5.01			5.31			5.61			5.91			6.21			6.51			6.81			7.11		
4.72			5.02			5.32	1	↑	5.62			5.92			6.22			6.52			6.82			7.12		
4.73			5.03			5.33		FGV	5.63			5.93			6.23			6.53			6.83			7.13		
4.74			5.04			5.34			5.64			5.94			6.24			6.54			6.84			7.14		
4.75			5.05			5.35			5.65			5.95			6.25			6.55			6.85			7.15		
4.76			5.06			5.36			5.66			5.96			6.26			6.56			6.86			7.16		
4.77			5.07			5.37			5.67			5.97	1		6.27			6.57			6.87			7.17		
4.78			5.08			5.38			5.68			5.98			6.28			6.58			6.88			7.18		
4.79			5.09			5.39			5.69			5.99			6.29			6.59			6.89			7.19		
4.80			5.10			5.40			5.70			6.00			6.30			6.60			6.90			7.20		
4.81			5.11			5.41			5.71	1		6.01			6.31			6.61			6.91			7.21		
4.82			5.12			5.42			5.72			6.02			6.32			6.62			6.92			7.22		
4.83			5.13			5.43			5.73			6.03			6.33			6.63			6.93			7.23		
4.84			5.14			5.44			5.74	1		6.04			6.34			6.64			6.94			7.24		
4.85			5.15			5.45			5.75			6.05			6.35			6.65			6.95			7.25		
4.86			5.16			5.46			5.76			6.06			6.36			6.66			6.96			7.26		
4.87			5.17			5.47			5.77			6.07			6.37			6.67			6.97			7.27		
4.88			5.18			5.48			5.78			6.08		FGV	6.38			6.68			6.98			7.28		
4.89			5.19			5.49	1		5.79			6.09	1	↓	6.39			6.69			6.99			7.29		

VITRINITE %		INERTINITE %						LIPTINITE %								OIL DROPS	BITUMEN
TV	DV	Sfus	Scler	Fus	Macr	ID	Micr	Spor	Cut	Sub	Res	Ld	Bituminite	Telalginite	Lamalginite	Oil	cut

Sample Number..L0835...Well Name...South Western,...Edwards 'B' No. 1-6,....GC967-6.1...................................... Depth....12370-12400Ft..... .... SampleType....Ctgs...
Date. ..11/.06/ 2006.. Op..SPR........ FGV - First Generation Vitrinite, RV - Reworked Vitrinite, BTT - Bituminite, B - Bitumen, Inert - Inertinite, Cav - Cavings, DA - Drilling Mud Additives

R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range
4.60			4.90			5.20			5.50			5.80			6.10			6.40			6.70			7.00		
4.61			4.91			5.21			5.51			5.81			6.11			6.41			6.71			7.01		
4.62			4.92			5.22			5.52			5.82	1	↑	6.12			6.42			6.72			7.02		
4.63			4.93			5.23			5.53			5.83		FGV	6.13			6.43			6.73			7.03		
4.64			4.94			5.24			5.54			5.84			6.14			6.44			6.74			7.04		
4.65			4.95			5.25			5.55			5.85			6.15			6.45			6.75			7.05		
4.66			4.96			5.26			5.56			5.86			6.16		FGV	6.46			6.76			7.06		
4.67			4.97			5.27			5.57			5.87			6.17	1	↓	6.47			6.77			7.07		
4.68			4.98			5.28			5.58			5.88			6.18			6.48			6.78			7.08		
4.69			4.99			5.29			5.59			5.89	1		6.19			6.49			6.79			7.09		
4.70			5.00			5.30			5.60			5.90			6.20			6.50			6.80			7.10		
4.71			5.01			5.31			5.61			5.91			6.21			6.51			6.81			7.11		
4.72			5.02			5.32			5.62			5.92			6.22			6.52			6.82			7.12		
4.73			5.03			5.33			5.63			5.93			6.23			6.53			6.83			7.13		
4.74			5.04			5.34			5.64			5.94			6.24			6.54			6.84			7.14		
4.75			5.05			5.35			5.65			5.95			6.25			6.55			6.85			7.15		
4.76			5.06			5.36			5.66			5.96			6.26			6.56			6.86			7.16		
4.77			5.07			5.37			5.67			5.97			6.27			6.57			6.87			7.17		
4.78			5.08			5.38			5.68			5.98			6.28			6.58			6.88			7.18		
4.79			5.09			5.39			5.69			5.99			6.29			6.59			6.89			7.19		
4.80			5.10			5.40			5.70			6.00			6.30			6.60			6.90			7.20		
4.81			5.11			5.41			5.71			6.01			6.31			6.61			6.91			7.21		
4.82			5.12			5.42			5.72			6.02			6.32			6.62			6.92			7.22		
4.83			5.13			5.43			5.73			6.03			6.33			6.63			6.93			7.23		
4.84			5.14			5.44			5.74			6.04			6.34			6.64			6.94			7.24		
4.85			5.15			5.45			5.75			6.05			6.35			6.65			6.95			7.25		
4.86			5.16			5.46			5.76			6.06			6.36			6.66			6.96			7.26		
4.87			5.17			5.47			5.77			6.07			6.37			6.67			6.97			7.27		
4.88			5.18			5.48			5.78			6.08			6.38			6.68			6.98			7.28		
4.89			5.19			5.49			5.79			6.09			6.39			6.69			6.99			7.29		

VITRINITE <0.1%		INERTINITE <0.1%						LIPTINITE -%								OIL DROPS	BITUMEN
TV	DV	Sfus	Scler	Fus	Macr	ID	Micr	Spor	Cut	Sub	Res	Ld	Bituminite	Telalginite	Lamalginite	Oil	cut

Sample Number..L0836...Well Name...South Western,...Edwards 'B' No. 1-6,....GC967-7.1...................................... Depth.....12900-12950Ft..... .... SampleType....Ctgs...
Date. ..11/.06/ 2006.. Op..SPR........ FGV - First Generation Vitrinite, RV - Reworked Vitrinite, BTT - Bituminite, B - Bitumen, Inert - Inertinite, Cav - Cavings, DA - Drilling Mud Additives

R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range
4.60			4.90			5.20			5.50			5.80			6.10			6.40			6.70			7.00		
4.61			4.91			5.21			5.51			5.81			6.11			6.41			6.71			7.01		
4.62			4.92			5.22			5.52			5.82			6.12			6.42	1		6.72			7.02		
4.63			4.93			5.23			5.53			5.83			6.13			6.43			6.73			7.03		
4.64			4.94			5.24			5.54			5.84			6.14			6.44	1		6.74			7.04		
4.65			4.95			5.25			5.55			5.85			6.15			6.45			6.75			7.05		
4.66			4.96			5.26			5.56			5.86			6.16			6.46			6.76	1		7.06		
4.67			4.97			5.27			5.57			5.87			6.17			6.47			6.77			7.07		
4.68			4.98			5.28			5.58			5.88			6.18	1	↑	6.48	1		6.78			7.08		
4.69			4.99			5.29			5.59			5.89			6.19		FGV	6.49	1		6.79			7.09		
4.70			5.00			5.30			5.60			5.90			6.20			6.50	1		6.80			7.10		
4.71			5.01			5.31			5.61			5.91			6.21			6.51	1		6.81			7.11		
4.72			5.02			5.32			5.62			5.92			6.22			6.52	1		6.82			7.12		
4.73			5.03			5.33			5.63			5.93			6.23			6.53			6.83			7.13		
4.74			5.04			5.34			5.64			5.94			6.24			6.54	1		6.84			7.14		
4.75			5.05			5.35			5.65			5.95			6.25	2		6.55			6.85			7.15		
4.76			5.06			5.36			5.66			5.96			6.26			6.56			6.86			7.16		
4.77			5.07			5.37			5.67			5.97			6.27	1		6.57			6.87			7.17		
4.78			5.08			5.38			5.68			5.98			6.28			6.58			6.88			7.18		
4.79			5.09			5.39			5.69			5.99			6.29			6.59			6.89		FGV	7.19		
4.80			5.10			5.40			5.70			6.00			6.30			6.60			6.90	1	↓	7.20		
4.81			5.11			5.41			5.71			6.01			6.31			6.61			6.91			7.21		
4.82			5.12			5.42			5.72			6.02			6.32			6.62			6.92			7.22		
4.83			5.13			5.43			5.73			6.03			6.33			6.63			6.93			7.23		
4.84			5.14			5.44			5.74			6.04			6.34			6.64	1		6.94			7.24		
4.85			5.15			5.45			5.75			6.05			6.35			6.65			6.95			7.25		
4.86			5.16			5.46			5.76			6.06			6.36			6.66			6.96			7.26		
4.87			5.17			5.47			5.77			6.07			6.37			6.67			6.97			7.27		
4.88			5.18			5.48			5.78			6.08			6.38	1		6.68			6.98			7.28		
4.89			5.19			5.49			5.79			6.09			6.39			6.69			6.99			7.29		

VITRINITE 0.1%		INERTINITE <0.1%						LIPTINITE -%								OIL DROPS	BITUMEN
TV	DV	Sfus	Scler	Fus	Macr	ID	Micr	Spor	Cut	Sub	Res	Ld	Bituminite	Telalginite	Lamalginite	Oil	cut

Sample Number..L0837...Well Name...South Western,...Edwards 'B' No. 1-6,....GC967-8.1...................................... Depth....13400-13450Ft..... .... SampleType....Ctgs...
Date. ..12/.06/ 2006.. Op..SPR........ FGV - First Generation Vitrinite, RV - Reworked Vitrinite, BTT - Bituminite, B - Bitumen, Inert - Inertinite, Cav - Cavings, DA - Drilling Mud Additives MICR D:\RWORK.ms6\967VRW06.doc

R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range
4.60			4.90			5.20			5.50			5.80			6.10			6.40			6.70			7.00		
4.61			4.91			5.21			5.51			5.81			6.11			6.41			6.71			7.01		
4.62			4.92			5.22			5.52			5.82			6.12			6.42			6.72			7.02		
4.63			4.93			5.23			5.53			5.83			6.13			6.43	1		6.73			7.03		
4.64			4.94			5.24			5.54			5.84			6.14			6.44			6.74			7.04		
4.65			4.95			5.25			5.55			5.85			6.15			6.45			6.75			7.05	1	
4.66			4.96			5.26			5.56			5.86			6.16			6.46	1		6.76	1		7.06		
4.67			4.97			5.27			5.57			5.87			6.17			6.47	1		6.77			7.07		
4.68			4.98			5.28			5.58			5.88			6.18			6.48			6.78			7.08		
4.69			4.99			5.29			5.59			5.89			6.19			6.49			6.79	1		7.09		
4.70			5.00			5.30			5.60			5.90			6.20			6.50			6.80			7.10		
4.71			5.01			5.31			5.61			5.91			6.21			6.51			6.81			7.11		
4.72			5.02			5.32			5.62			5.92			6.22			6.52			6.82			7.12		
4.73			5.03			5.33			5.63			5.93			6.23			6.53			6.83			7.13		
4.74			5.04			5.34			5.64			5.94			6.24	1	↑	6.54			6.84			7.14		
4.75			5.05			5.35			5.65			5.95			6.25		FGV	6.55	1		6.85	1		7.15		
4.76			5.06			5.36			5.66			5.96			6.26			6.56	1		6.86			7.16		
4.77			5.07			5.37			5.67			5.97			6.27			6.57			6.87			7.17		
4.78			5.08			5.38			5.68			5.98			6.28			6.58			6.88			7.18		
4.79			5.09			5.39			5.69			5.99			6.29			6.59			6.89			7.19		
4.80			5.10			5.40			5.70			6.00			6.30			6.60			6.90			7.20		
4.81			5.11			5.41			5.71			6.01			6.31			6.61			6.91	1		7.21		FGV
4.82			5.12			5.42			5.72			6.02			6.32			6.62			6.92			7.22	1	↓
4.83			5.13			5.43			5.73			6.03			6.33	1		6.63	1		6.93	1		7.23		
4.84			5.14			5.44			5.74			6.04			6.34			6.64			6.94			7.24		
4.85			5.15			5.45			5.75			6.05			6.35			6.65	1		6.95			7.25		
4.86			5.16			5.46			5.76			6.06			6.36			6.66			6.96			7.26		
4.87			5.17			5.47			5.77			6.07			6.37			6.67			6.97			7.27		
4.88			5.18			5.48			5.78			6.08			6.38	1		6.68			6.98			7.28		
4.89			5.19			5.49			5.79			6.09			6.39			6.69			6.99	1		7.29		

VITRINITE 0.2%		INERTINITE <0.1%						LIPTINITE -%								OIL DROPS	BITUMEN
TV	DV	Sfus	Scler	Fus	Macr	ID	Micr	Spor	Cut	Sub	Res	Ld	Bituminite	Telalginite	Lamalginite	Oil cut	

Sample Number..L0838...Well Name...South Western,...Edwards 'B' No. 1-6,....GC967-9.1....................................... Depth....13950-14000Ft..... .... SampleType....Ctgs...
Date. ..12/.06/ 2006.. Op..SPR........ FGV - First Generation Vitrinite, RV - Reworked Vitrinite, BTT - Bituminite, B - Bitumen, Inert - Inertinite, Cav - Cavings, DA - Drilling Mud Additives MICR D:\RWORK.ms6\967VRW06.doc

R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range
4.60			4.90			5.20			5.50			5.80			6.10			6.40			6.70			7.00		
4.61			4.91			5.21			5.51			5.81			6.11			6.41	1		6.71			7.01		
4.62			4.92			5.22			5.52			5.82			6.12			6.42			6.72			7.02		
4.63			4.93			5.23			5.53			5.83			6.13			6.43			6.73	1		7.03	1	
4.64			4.94			5.24			5.54			5.84			6.14			6.44			6.74			7.04		
4.65			4.95			5.25			5.55			5.85			6.15			6.45	1		6.75			7.05		
4.66			4.96			5.26			5.56			5.86			6.16			6.46			6.76	3		7.06		
4.67			4.97			5.27			5.57			5.87			6.17			6.47			6.77	1		7.07		
4.68			4.98			5.28			5.58			5.88			6.18			6.48			6.78			7.08		
4.69			4.99			5.29			5.59			5.89			6.19			6.49			6.79			7.09		
4.70			5.00			5.30			5.60			5.90			6.20	1	↑	6.50			6.80			7.10		
4.71			5.01			5.31			5.61			5.91			6.21		FGV	6.51			6.81	1		7.11		
4.72			5.02			5.32			5.62			5.92			6.22	1		6.52	1		6.82			7.12		
4.73			5.03			5.33			5.63			5.93			6.23			6.53			6.83			7.13		
4.74			5.04			5.34			5.64			5.94			6.24			6.54	1		6.84			7.14		
4.75			5.05			5.35			5.65			5.95			6.25			6.55			6.85			7.15		
4.76			5.06			5.36			5.66			5.96			6.26			6.56			6.86			7.16		
4.77			5.07			5.37			5.67			5.97			6.27			6.57			6.87			7.17		
4.78			5.08			5.38			5.68			5.98			6.28			6.58			6.88			7.18		
4.79			5.09			5.39			5.69			5.99			6.29			6.59	1		6.89			7.19		
4.80			5.10			5.40			5.70			6.00			6.30			6.60			6.90			7.20		
4.81			5.11			5.41			5.71			6.01			6.31			6.61			6.91	1		7.21		
4.82			5.12			5.42			5.72			6.02			6.32	1		6.62			6.92			7.22		
4.83			5.13			5.43			5.73			6.03			6.33			6.63			6.93			7.23		
4.84			5.14			5.44			5.74			6.04			6.34			6.64			6.94			7.24		
4.85			5.15			5.45			5.75			6.05			6.35			6.65	1		6.95			7.25		
4.86			5.16			5.46			5.76			6.06			6.36			6.66			6.96			7.26		
4.87			5.17			5.47			5.77			6.07			6.37			6.67			6.97			7.27		
4.88			5.18			5.48			5.78			6.08			6.38			6.68	1		6.98			7.28		FGV
4.89			5.19			5.49			5.79			6.09			6.39			6.69	1		6.99			7.29	1	↓

VITRINITE 0.4 %		INERTINITE <0.1%						LIPTINITE -%								OIL DROPS	BITUMEN
TV	DV	Sfus	Scler	Fus	Macr	ID	Micr	Spor	Cut	Sub	Res	Ld	Bituminite	Telalginite	Lamalginite	Oil cut	

Sample Number..L0839...Well Name...South Western,...Edwards 'B' No. 1-6,....GC967-10.1................................ Depth....14470-14520Ft..... .... SampleType....Ctgs...
Date. ..12/.06/ 2006.. Op..SPR........ FGV - First Generation Vitrinite, RV - Reworked Vitrinite, BTT - Bituminite, B - Bitumen, Inert - Inertinite, Cav - Cavings, DA - Drilling Mud Additives MICR D:\RWORK.ms6\967VRW06.doc

R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range
4.60			4.90			5.20			5.50			5.80			6.10			6.40	1		6.70			7.00		
4.61			4.91			5.21			5.51			5.81			6.11			6.41			6.71	1		7.01		
4.62			4.92			5.22			5.52			5.82			6.12			6.42			6.72			7.02		
4.63			4.93			5.23			5.53			5.83			6.13			6.43			6.73			7.03		
4.64			4.94			5.24			5.54			5.84			6.14			6.44	1		6.74	1		7.04		
4.65			4.95			5.25			5.55			5.85			6.15			6.45			6.75			7.05		
4.66			4.96			5.26			5.56			5.86			6.16			6.46	1		6.76			7.06		
4.67			4.97			5.27			5.57			5.87			6.17			6.47			6.77			7.07		
4.68			4.98			5.28			5.58			5.88			6.18			6.48			6.78			7.08		
4.69			4.99			5.29			5.59			5.89			6.19			6.49			6.79			7.09		
4.70			5.00			5.30			5.60			5.90			6.20			6.50			6.80			7.10		
4.71			5.01			5.31			5.61			5.91			6.21			6.51			6.81			7.11		FGV
4.72			5.02			5.32			5.62			5.92			6.22			6.52			6.82	1		7.12	1	↓
4.73			5.03			5.33			5.63			5.93			6.23			6.53	1		6.83			7.13		
4.74			5.04			5.34			5.64			5.94			6.24			6.54			6.84			7.14		
4.75			5.05			5.35			5.65			5.95			6.25			6.55			6.85			7.15		
4.76			5.06			5.36			5.66			5.96			6.26			6.56			6.86	1		7.16		
4.77			5.07			5.37			5.67			5.97			6.27			6.57			6.87			7.17		
4.78			5.08			5.38			5.68			5.98			6.28			6.58			6.88			7.18		
4.79			5.09			5.39			5.69			5.99			6.29			6.59			6.89			7.19		
4.80			5.10			5.40			5.70			6.00			6.30			6.60			6.90	1		7.20		
4.81			5.11			5.41			5.71			6.01			6.31			6.61			6.91	1		7.21		
4.82			5.12			5.42			5.72			6.02			6.32			6.62			6.92			7.22		
4.83			5.13			5.43			5.73			6.03			6.33			6.63	1		6.93			7.23		
4.84			5.14			5.44			5.74			6.04			6.34			6.64			6.94			7.24		
4.85			5.15			5.45			5.75			6.05			6.35			6.65			6.95			7.25		
4.86			5.16			5.46			5.76			6.06			6.36			6.66	1		6.96			7.26		
4.87			5.17			5.47			5.77			6.07			6.37			6.67			6.97			7.27		
4.88			5.18			5.48			5.78			6.08			6.38	1	↑	6.68			6.98	1		7.28		
4.89			5.19			5.49			5.79			6.09			6.39		FGV	6.69			6.99	1		7.29		

VITRINITE 0.4%		INERTINITE <0.1%						LIPTINITE -%								OIL DROPS	BITUMEN
TV	DV	Sfus	Scler	Fus	Macr	ID	Micr	Spor	Cut	Sub	Res	Ld	Bituminite	Telalginite	Lamalginite	Oil cut	

Sample Number..L0840...Well Name...South Western,...Edwards ‘B’ No. 1-6,....GC967-11.1................................. Depth....14950-15000Ft..... .... SampleType....Ctgs...
Date. ..12/.06/ 2006.. Op..SPR........ FGV - First Generation Vitrinite, RV - Reworked Vitrinite, BTT - Bituminite, B - Bitumen, Inert - Inertinite, Cav - Cavings, DA - Drilling Mud Additives MICR D:\RWORK.ms6\967VRW06.doc

R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range
5.15	1	↑	5.50			5.80			6.10	1		6.40			6.70			7.00			7.30			7.60		
5.21		Pop2	5.51	1		5.81			6.11	1		6.41			6.71			7.01			7.31			7.61		
5.22			5.52	1		5.82			6.12			6.42			6.72			7.02			7.32			7.62		
5.23			5.53	1		5.83			6.13			6.43			6.73			7.03			7.33			7.63		
5.24			5.54	1		5.84			6.14			6.44			6.74			7.04			7.34			7.64		
5.25	1		5.55			5.85			6.15			6.45			6.75			7.05			7.35			7.65		
5.26			5.56			5.86			6.16			6.46			6.76			7.06			7.36			7.66		
5.27			5.57			5.87			6.17			6.47			6.77			7.07			7.37			7.67		
5.28			5.58			5.88			6.18			6.48			6.78			7.08			7.38			7.68		
5.29			5.59			5.89	1		6.19			6.49			6.79			7.09			7.39			7.69		
5.30			5.60			5.90			6.20			6.50			6.80			7.10			7.40			7.70		
5.31			5.61			5.91	2		6.21			6.51			6.81			7.11			7.41			7.71		
5.32			5.62	1		5.92			6.22			6.52			6.82			7.12			7.42			7.72		
5.33			5.63			5.93			6.23			6.53			6.83			7.13			7.43			7.73		
5.34			5.64			5.94			6.24		Pop2	6.54			6.84			7.14			7.44			7.74		
5.35			5.65	1		5.95			6.25	1	↓	6.55			6.85			7.15			7.45			7.75		
5.36			5.66			5.96			6.26			6.56			6.86			7.16			7.46			7.76		
5.37			5.67			5.97			6.27			6.57			6.87			7.17			7.47			7.77		
5.38			5.68			5.98			6.28			6.58			6.88			7.18			7.48			7.78		
5.39	1		5.69			5.99			6.29			6.59			6.89			7.19			7.49			7.79		
5.40			5.70			6.00			6.30			6.60			6.90			7.20			7.50			7.80		
5.41			5.71	1		6.01			6.31			6.61			6.91			7.21			7.51			7.81		
5.42			5.72			6.02	1		6.32			6.62			6.92			7.22			7.52			7.82		
5.43	2		5.73			6.03			6.33			6.63			6.93			7.23			7.53			7.83		
5.44	1		5.74			6.04			6.34			6.64			6.94			7.24			7.54			7.84		
5.45	1		5.75			6.05			6.35			6.65			6.95			7.25			7.55			7.85		
5.46			5.76			6.06	1		6.36			6.66			6.96			7.26			7.56			7.88	1	↑
5.47			5.77	2		6.07			6.37			6.67			6.97			7.27			7.57			7.90	1	Pop1
5.48			5.78	1		6.08			6.38			6.68			6.98			7.28			7.58			8.38	1	↓
5.49			5.79			6.09			6.39			6.69			6.99			7.29			7.59			8.39		

VITRINITE 1.4%		INERTINITE 0.6%						LIPTINITE -%								OIL DROPS	BITUMEN
TV	DV	Sfus	Scler	Fus	Macr	ID	Micr	Spor	Cut	Sub	Res	Ld	Bituminite	Telalginite	Lamalginite	Oil	cut

Sample Number..L0841...Well Name...South Western,...Hunt USA No.1-1,....GC967-12.1...................................... Depth...11400-11450Ft..... .... SampleType....Ctgs...
Date. ..12/.06/ 2006.. Op..SPR........ FGV - First Generation Vitrinite, RV - Reworked Vitrinite, BTT - Bituminite, B - Bitumen, Inert - Inertinite, Cav - Cavings, DA - Drilling Mud Additives

R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range
5.20			5.50			5.80			6.10			6.40			6.70			7.00			7.30			7.60		
5.21			5.51			5.81			6.11			6.41			6.71			7.01			7.31			7.61		
5.22			5.52			5.82			6.12			6.42			6.72			7.02			7.32			7.62		
5.23			5.53			5.83	2		6.13			6.43			6.73			7.03			7.33			7.63		
5.24			5.54			5.84			6.14			6.44			6.74			7.04			7.34			7.64		
5.25			5.55			5.85			6.15			6.45			6.75			7.05			7.35			7.65		
5.26			5.56	1	↑	5.86			6.16			6.46			6.76			7.06			7.36			7.66		
5.27			5.57	1	FGV	5.87	1		6.17			6.47			6.77			7.07			7.37			7.67		
5.28			5.58			5.88			6.18			6.48			6.78			7.08			7.38			7.68		
5.29			5.59			5.89			6.19		FGV	6.49			6.79			7.09			7.39			7.69		
5.30			5.60			5.90			6.20	1	↓	6.50			6.80			7.10			7.40			7.70		
5.31			5.61	1		5.91			6.21			6.51			6.81			7.11			7.41			7.71		
5.32			5.62			5.92			6.22			6.52			6.82			7.12			7.42			7.72		
5.33			5.63			5.93			6.23			6.53			6.83			7.13			7.43			7.73		
5.34			5.64	1		5.94	1		6.24			6.54			6.84			7.14			7.44			7.74		
5.35			5.65	1		5.95	1		6.25			6.55			6.85			7.15			7.45			7.75		
5.36			5.66			5.96			6.26			6.56			6.86			7.16			7.46			7.76		
5.37			5.67			5.97	1		6.27			6.57			6.87			7.17			7.47			7.77		
5.38			5.68			5.98	1		6.28			6.58			6.88			7.18			7.48			7.78		
5.39			5.69			5.99			6.29			6.59			6.89			7.19			7.49			7.79		
5.40			5.70			6.00			6.30			6.60			6.90			7.20			7.50			7.80		
5.41			5.71			6.01	1		6.31			6.61			6.91			7.21			7.51			7.81		
5.42			5.72			6.02			6.32			6.62			6.92			7.22			7.52			7.82		
5.43			5.73			6.03			6.33			6.63			6.93			7.23			7.53			7.83		
5.44			5.74			6.04			6.34			6.64			6.94			7.24			7.54			7.84		
5.45			5.75			6.05			6.35			6.65			6.95			7.25			7.55			7.85		
5.46			5.76			6.06			6.36			6.66			6.96			7.26			7.56			7.86		
5.47			5.77			6.07	1		6.37			6.67			6.97			7.27			7.57			7.87		
5.48			5.78			6.08			6.38			6.68			6.98			7.28			7.58			7.88		
5.49			5.79	1		6.09			6.39			6.69			6.99			7.29			7.59			7.89		

VITRINITE 0.5%		INERTINITE 0.3%						LIPTINITE -%								OIL DROPS	BITUMEN
TV	DV	Sfus	Scler	Fus	Macr	ID	Micr	Spor	Cut	Sub	Res	Ld	Bituminite	Telalginite	Lamalginite	Oil	cut

Sample Number..L0842...Well Name...South Western,...Hunt USA No.1-1,....GC967-13.1..................................... Depth...11900-11920Ft..... .... SampleType....Ctgs...
Date. ..12/.06/ 2006.. Op..SPR........ FGV - First Generation Vitrinite, RV - Reworked Vitrinite, BTT - Bituminite, B - Bitumen, Inert - Inertinite, Cav - Cavings, DA - Drilling Mud Additives MICR D:\RWORK.ms6\967VRW06.doc

R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range
5.20			5.50			5.80	1		6.10			6.40			6.70			7.00			7.30			7.60		
5.21			5.51			5.81			6.11			6.41			6.71			7.01			7.31			7.61		
5.22			5.52			5.82			6.12	1		6.42			6.72			7.02			7.32			7.62		
5.23			5.53			5.83	1		6.13			6.43			6.73			7.03			7.33			7.63		
5.24			5.54			5.84			6.14			6.44			6.74			7.04			7.34			7.64		
5.25			5.55			5.85			6.15			6.45			6.75			7.05			7.35			7.65		
5.26			5.56	1	↑	5.86			6.16			6.46			6.76			7.06			7.36			7.66		
5.27			5.57		FGV	5.87			6.17			6.47			6.77			7.07			7.37			7.67		
5.28			5.58			5.88			6.18	1		6.48			6.78			7.08			7.38			7.68		
5.29			5.59			5.89			6.19			6.49			6.79			7.09			7.39			7.69		
5.30			5.60			5.90	1		6.20	1		6.50			6.80			7.10			7.40			7.70		
5.31			5.61			5.91			6.21			6.51			6.81			7.11			7.41			7.71		
5.32			5.62			5.92			6.22	1		6.52			6.82			7.12			7.42			7.72		
5.33			5.63			5.93			6.23			6.53			6.83			7.13			7.43			7.73		
5.34			5.64			5.94	2		6.24			6.54			6.84			7.14			7.44			7.74		
5.35			5.65			5.95			6.25			6.55		FGV	6.85			7.15			7.45			7.75		
5.36			5.66			5.96			6.26			6.56	1	↓	6.86			7.16			7.46			7.76		
5.37			5.67			5.97			6.27			6.57			6.87			7.17			7.47			7.77		
5.38			5.68			5.98			6.28			6.58			6.88			7.18			7.48			7.78		
5.39			5.69	1		5.99			6.29			6.59			6.89			7.19			7.49			7.79		
5.40			5.70			6.00			6.30			6.60			6.90			7.20			7.50			7.80		
5.41			5.71			6.01			6.31			6.61			6.91			7.21			7.51			7.81		
5.42			5.72			6.02			6.32	1		6.62			6.92			7.22			7.52			7.82		
5.43			5.73			6.03			6.33			6.63			6.93			7.23			7.53			7.83		
5.44			5.74			6.04	1		6.34			6.64			6.94			7.24			7.54			7.84		
5.45			5.75			6.05			6.35			6.65			6.95			7.25			7.55			7.85		
5.46			5.76			6.06			6.36	1		6.66			6.96			7.26			7.56			7.86		
5.47			5.77			6.07			6.37			6.67			6.97			7.27			7.57			7.87		
5.48			5.78			6.08			6.38			6.68			6.98			7.28			7.58			7.88		
5.49			5.79			6.09			6.39			6.69			6.99			7.29			7.59			7.89		

VITRINITE 0.3%		INERTINITE 0.6%						LIPTINITE -%								OIL DROPS	BITUMEN
TV	DV	Sfus	Scler	Fus	Macr	ID	Micr	Spor	Cut	Sub	Res	Ld	Bituminite	Telalginite	Lamalginite	Oil	cut

Sample Number..L0843...Well Name...South Western,...Hunt USA No.1-1,....GC967-14.1.................................... Depth...12450-12500Ft..... .... SampleType....Ctgs...
Date. ..12/.06/ 2006.. Op..SPR........ FGV - First Generation Vitrinite, RV - Reworked Vitrinite, BTT - Bituminite, B - Bitumen, Inert - Inertinite, Cav - Cavings, DA - Drilling Mud Additives

R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range
5.20			5.50			5.80			6.10			6.40			6.70			7.00			7.30			7.60		
5.21			5.51			5.81	1		6.11			6.41			6.71			7.01			7.31			7.61		
5.22			5.52			5.82	1		6.12			6.42			6.72			7.02			7.32			7.62		
5.23			5.53			5.83			6.13			6.43			6.73			7.03			7.33			7.63		
5.24			5.54			5.84			6.14			6.44			6.74			7.04			7.34			7.64		
5.25			5.55			5.85	1		6.15			6.45			6.75			7.05			7.35			7.65		
5.26			5.56			5.86	1		6.16	1		6.46			6.76			7.06			7.36			7.66		
5.27			5.57			5.87			6.17			6.47	1		6.77			7.07			7.37			7.67		
5.28			5.58			5.88			6.18			6.48			6.78			7.08			7.38			7.68		
5.29			5.59			5.89			6.19			6.49			6.79			7.09			7.39			7.69		
5.30			5.60			5.90			6.20			6.50			6.80			7.10			7.40			7.70		
5.31			5.61			5.91			6.21			6.51			6.81			7.11			7.41			7.71		
5.32			5.62			5.92			6.22	1		6.52			6.82			7.12			7.42			7.72		
5.33			5.63			5.93	1		6.23			6.53	1		6.83			7.13			7.43			7.73		
5.34			5.64			5.94			6.24			6.54			6.84			7.14			7.44			7.74		
5.35			5.65			5.95	1		6.25			6.55			6.85			7.15			7.45			7.75		
5.36			5.66			5.96			6.26			6.56			6.86			7.16			7.46			7.76		
5.37			5.67			5.97	1		6.27			6.57			6.87			7.17			7.47			7.77		
5.38			5.68			5.98			6.28			6.58		FGV	6.88			7.18			7.48			7.78		
5.39			5.69			5.99			6.29	1		6.59	1	↓	6.89			7.19			7.49			7.79		
5.40			5.70			6.00			6.30			6.60			6.90			7.20			7.50			7.80		
5.41			5.71			6.01	1		6.31			6.61			6.91			7.21			7.51			7.81		
5.42			5.72			6.02			6.32			6.62			6.92			7.22			7.52			7.82		
5.43			5.73	2	↑	6.03	1		6.33			6.63			6.93			7.23			7.53			7.83		
5.44			5.74		FGV	6.04			6.34	1		6.64			6.94			7.24			7.54			7.84		
5.45			5.75			6.05			6.35	1		6.65			6.95			7.25			7.55			7.85		
5.46			5.76			6.06	1		6.36	1		6.66			6.96			7.26			7.56			7.86		
5.47			5.77	1		6.07			6.37	1		6.67			6.97			7.27			7.57			7.87		
5.48			5.78	1		6.08	1		6.38			6.68			6.98			7.28			7.58			7.88		
5.49			5.79			6.09			6.39			6.69			6.99			7.29			7.59			7.89		

VITRINITE 0.5%		INERTINITE 0.3%						LIPTINITE -%								OIL DROPS	BITUMEN
TV	DV	Sfus	Scler	Fus	Macr	ID	Micr	Spor	Cut	Sub	Res	Ld	Bituminite	Telalginite	Lamalginite	Oil	cut

Sample Number..L0844...Well Name...South Western,...Hunt USA No.1-1,....GC967-15.1...................................... Depth...12850-12900Ft..... .... SampleType....Ctgs...
Date. ..13/.06/ 2006.. Op..SPR........ FGV - First Generation Vitrinite, RV - Reworked Vitrinite, BTT - Bituminite, B - Bitumen, Inert - Inertinite, Cav - Cavings, DA - Drilling Mud Additives MICR D:\RWORK.ms6\967VRW06.doc

R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range
5.20			5.50			5.80			6.10			6.40			6.70		FGV	7.00			7.30			7.60		
5.21			5.51			5.81			6.11			6.41			6.71	1	↓	7.01			7.31			7.61		
5.22			5.52			5.82			6.12			6.42			6.72			7.02			7.32			7.62		
5.23			5.53			5.83			6.13			6.43			6.73			7.03			7.33			7.63		
5.24			5.54			5.84			6.14	1		6.44			6.74			7.04			7.34			7.64		
5.25			5.55			5.85			6.15			6.45			6.75			7.05			7.35			7.65		
5.26			5.56			5.86			6.16	1		6.46			6.76			7.06			7.36			7.66		
5.27			5.57			5.87			6.17			6.47			6.77			7.07			7.37			7.67		
5.28			5.58			5.88			6.18			6.48			6.78			7.08			7.38			7.68		
5.29			5.59			5.89			6.19	1		6.49			6.79			7.09			7.39			7.69		
5.30			5.60			5.90			6.20			6.50			6.80			7.10			7.40			7.70		
5.31			5.61			5.91			6.21			6.51			6.81			7.11			7.41			7.71		
5.32			5.62			5.92			6.22			6.52			6.82			7.12			7.42			7.72		
5.33			5.63			5.93	2	↑	6.23			6.53			6.83			7.13			7.43			7.73		
5.34			5.64			5.94		FGV	6.24			6.54			6.84			7.14			7.44			7.74		
5.35			5.65			5.95			6.25			6.55	1		6.85			7.15			7.45			7.75		
5.36			5.66			5.96			6.26			6.56			6.86			7.16			7.46			7.76		
5.37			5.67			5.97			6.27			6.57			6.87			7.17			7.47			7.77		
5.38			5.68			5.98			6.28	1		6.58			6.88			7.18			7.48			7.78		
5.39			5.69			5.99			6.29			6.59			6.89			7.19			7.49			7.79		
5.40			5.70			6.00	1		6.30			6.60			6.90			7.20			7.50			7.80		
5.41			5.71			6.01	1		6.31			6.61			6.91			7.21			7.51			7.81		
5.42			5.72			6.02			6.32	1		6.62			6.92			7.22			7.52			7.82		
5.43			5.73			6.03			6.33			6.63			6.93			7.23			7.53			7.83		
5.44			5.74			6.04			6.34			6.64			6.94			7.24			7.54			7.84		
5.45			5.75			6.05			6.35			6.65			6.95			7.25			7.55			7.85		
5.46			5.76			6.06			6.36			6.66			6.96			7.26			7.56			7.86		
5.47			5.77			6.07	1		6.37			6.67			6.97			7.27			7.57			7.87		
5.48			5.78			6.08	1		6.38			6.68			6.98			7.28			7.58			7.88		
5.49			5.79			6.09			6.39			6.69			6.99			7.29			7.59			7.89		

VITRINITE 0.4%		INERTINITE 0.1%						LIPTINITE -%								OIL DROPS	BITUMEN
TV	DV	Sfus	Scler	Fus	Macr	ID	Micr	Spor	Cut	Sub	Res	Ld	Bituminite	Telalginite	Lamalginite	Oil cut	

Sample Number..L0845...Well Name...South Western,...Hunt USA No.1-1,....GC967-16.1....................................... Depth...13660-13700Ft..... .... SampleType....Ctgs...
Date. ..13/.06/ 2006.. Op..SPR........ FGV - First Generation Vitrinite, RV - Reworked Vitrinite, BTT - Bituminite, B - Bitumen, Inert - Inertinite, Cav - Cavings, DA - Drilling Mud Additives MICR D:\RWORK.ms6\967VRW06.doc

R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range
5.20			5.50			5.80			6.10			6.40			6.70			7.00			7.30			7.60		
5.21			5.51			5.81			6.11	1		6.41			6.71			7.01			7.31			7.61		
5.22			5.52			5.82			6.12			6.42	2		6.72			7.02			7.32			7.62		
5.23			5.53			5.83			6.13			6.43	1		6.73			7.03			7.33			7.63		
5.24			5.54			5.84	1	↑	6.14			6.44			6.74			7.04			7.34			7.64		
5.25			5.55			5.85		Pop2	6.15	1		6.45			6.75			7.05			7.35			7.65		
5.26			5.56			5.86			6.16			6.46			6.76			7.06			7.36			7.66		
5.27			5.57			5.87			6.17			6.47			6.77			7.07			7.37			7.67		
5.28			5.58			5.88			6.18	1		6.48			6.78			7.08			7.38			7.68		
5.29			5.59			5.89			6.19			6.49	1		6.79			7.09			7.39			7.69		
5.30			5.60			5.90			6.20			6.50			6.80			7.10			7.40			7.70		
5.31			5.61			5.91			6.21	1		6.51			6.81			7.11			7.41			7.71		
5.32			5.62			5.92	1		6.22			6.52			6.82			7.12			7.42			7.72		
5.33			5.63			5.93			6.23			6.53			6.83			7.13			7.43			7.73		
5.34			5.64			5.94			6.24	1		6.54			6.84			7.14			7.44			7.74		
5.35			5.65			5.95			6.25			6.55		Pop2	6.85			7.15			7.45			7.75		
5.36			5.66			5.96			6.26	1		6.56	1	↓	6.86			7.16			7.46			7.76		
5.37			5.67			5.97			6.27			6.57			6.87			7.17			7.47			7.77		
5.38			5.68			5.98			6.28	1		6.58			6.88			7.18			7.48			7.78		
5.39			5.69			5.99			6.29			6.59			6.89			7.19			7.49			7.79		
5.40			5.70			6.00			6.30	2		6.60			6.90			7.20			7.50			7.80		
5.41			5.71			6.01			6.31	2		6.61			6.91			7.21			7.51			7.81		
5.42			5.72			6.02			6.32			6.62			6.92			7.22			7.52			7.82		
5.43			5.73			6.03			6.33			6.63			6.93			7.23			7.53			7.83		
5.44			5.74			6.04			6.34			6.64			6.94			7.24			7.54			7.84		
5.45			5.75			6.05	1		6.35	1		6.65			6.95			7.25			7.55			7.85		
5.46			5.76			6.06			6.36			6.66			6.96			7.26			7.56			7.86		
5.47			5.77			6.07	2		6.37			6.67			6.97			7.27			7.57			7.87	1	↑
5.48			5.78			6.08	1		6.38	1		6.68			6.98			7.28			7.58			8.18	1	Pop1
5.49			5.79			6.09	1		6.39			6.69			6.99			7.29			7.59			8.33	1	↓

VITRINITE 1.5%		INERTINITE 0.4%						LIPTINITE -%								OIL DROPS	BITUMEN
TV	DV	Sfus	Scler	Fus	Macr	ID	Micr	Spor	Cut	Sub	Res	Ld	Bituminite	Telalginite	Lamalginite	Oil cut	

Sample Number..L0846...Well Name...South Western,...Hunt USA No.1-1,....GC967-17.1...................................... Depth...14140-14170Ft..... .... SampleType....Ctgs...
Date. ..13/.06/ 2006.. Op..SPR........ FGV - First Generation Vitrinite, RV - Reworked Vitrinite, BTT - Bituminite, B - Bitumen, Inert - Inertinite, Cav - Cavings, DA - Drilling Mud Additives MICR D:\RWORK.ms6\967VRW06.doc

R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range
5.20			5.50			5.80			6.10	1		6.40			6.70			7.00			7.30			7.60		
5.21			5.51			5.81			6.11			6.41			6.71			7.01			7.31			7.61		
5.22			5.52			5.82			6.12	1		6.42			6.72			7.02			7.32			7.62		
5.23			5.53			5.83			6.13	1		6.43			6.73			7.03			7.33			7.63		
5.24			5.54			5.84			6.14			6.44			6.74			7.04			7.34			7.64		
5.25			5.55			5.85			6.15			6.45			6.75			7.05			7.35			7.65		
5.26			5.56			5.86			6.16			6.46			6.76			7.06			7.36			7.66		
5.27			5.57			5.87			6.17	1		6.47			6.77			7.07			7.37			7.67		
5.28			5.58			5.88			6.18	1		6.48			6.78			7.08			7.38			7.68		
5.29			5.59			5.89			6.19			6.49			6.79			7.09			7.39			7.69		
5.30			5.60			5.90			6.20	1		6.50			6.80			7.10			7.40			7.70		
5.31			5.61			5.91			6.21			6.51			6.81			7.11			7.41			7.71		
5.32			5.62			5.92			6.22			6.52			6.82			7.12			7.42			7.72		
5.33			5.63			5.93			6.23	1		6.53			6.83			7.13			7.43			7.73		
5.34			5.64			5.94			6.24			6.54			6.84			7.14			7.44			7.74		
5.35			5.65			5.95			6.25			6.55			6.85			7.15			7.45			7.75		
5.36			5.66			5.96			6.26			6.56			6.86			7.16			7.46			7.76		
5.37			5.67			5.97			6.27			6.57		FGV	6.87			7.17			7.47			7.77		
5.38			5.68			5.98			6.28			6.58	1	↓	6.88			7.18			7.48			7.78		
5.39			5.69			5.99			6.29			6.59			6.89			7.19			7.49			7.79		
5.40			5.70			6.00			6.30			6.60			6.90			7.20			7.50			7.80		
5.41			5.71			6.01			6.31			6.61			6.91			7.21			7.51			7.81		
5.42			5.72			6.02	1	↑	6.32			6.62			6.92			7.22			7.52			7.82		
5.43			5.73			6.03		FGV	6.33			6.63			6.93			7.23			7.53			7.83		
5.44			5.74			6.04			6.34			6.64			6.94			7.24			7.54			7.84		
5.45			5.75			6.05			6.35			6.65			6.95			7.25			7.55			7.85		
5.46			5.76			6.06			6.36	1		6.66			6.96			7.26			7.56			7.86		
5.47			5.77			6.07	2		6.37			6.67			6.97			7.27			7.57			7.87		
5.48			5.78			6.08			6.38			6.68			6.98			7.28			7.58			7.88		
5.49			5.79			6.09			6.39			6.69			6.99			7.29			7.59			7.89		

VITRINITE 0.4%		INERTINITE 0.1%						LIPTINITE -%								OIL DROPS	BITUMEN
TV	DV	Sfus	Scler	Fus	Macr	ID	Micr	Spor	Cut	Sub	Res	Ld	Bituminite	Telalginite	Lamalginite	Oil cut	

Sample Number..L0847...Well Name...South Western,...Hunt USA No.1-1,....GC967-18.1....................................... Depth...14610-14630Ft..... .... SampleType....Ctgs...
Date. ..13/.06/ 2006.. Op..SPR........ FGV - First Generation Vitrinite, RV - Reworked Vitrinite, BTT - Bituminite, B - Bitumen, Inert - Inertinite, Cav - Cavings, DA - Drilling Mud Additives MICR D:\RWORK.ms6\967VRW06.doc

R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range
5.20			5.50			5.80			6.10			6.40			6.70			7.00			7.30			7.60		
5.21			5.51			5.81			6.11			6.41			6.71			7.01			7.31			7.61		
5.22			5.52			5.82			6.12			6.42			6.72			7.02			7.32			7.62		
5.23			5.53			5.83			6.13	1		6.43			6.73			7.03			7.33			7.63		
5.24			5.54			5.84			6.14	1		6.44			6.74			7.04			7.34			7.64		
5.25			5.55			5.85			6.15	1		6.45	1		6.75			7.05			7.35			7.65		
5.26			5.56			5.86			6.16			6.46			6.76			7.06			7.36			7.66		
5.27			5.57			5.87			6.17			6.47	2		6.77			7.07			7.37			7.67		
5.28			5.58			5.88			6.18			6.48			6.78			7.08			7.38			7.68		
5.29			5.59			5.89			6.19			6.49			6.79		FGV	7.09			7.39			7.69		
5.30			5.60			5.90			6.20			6.50			6.80	1	↓	7.10			7.40			7.70		
5.31			5.61			5.91	1	↑	6.21			6.51			6.81			7.11			7.41			7.71		
5.32			5.62			5.92		FGV	6.22			6.52			6.82			7.12			7.42			7.72		
5.33			5.63			5.93			6.23			6.53			6.83			7.13			7.43			7.73		
5.34			5.64			5.94			6.24			6.54			6.84			7.14			7.44			7.74		
5.35			5.65			5.95			6.25			6.55			6.85			7.15			7.45			7.75		
5.36			5.66			5.96			6.26			6.56			6.86			7.16			7.46			7.76		
5.37			5.67			5.97			6.27			6.57			6.87			7.17			7.47			7.77		
5.38			5.68			5.98			6.28			6.58			6.88			7.18			7.48			7.78		
5.39			5.69			5.99			6.29			6.59			6.89			7.19			7.49			7.79		
5.40			5.70			6.00			6.30			6.60			6.90			7.20			7.50			7.80		
5.41			5.71			6.01			6.31			6.61			6.91			7.21			7.51			7.81		
5.42			5.72			6.02			6.32			6.62			6.92			7.22			7.52			7.82		
5.43			5.73			6.03			6.33			6.63	1		6.93			7.23			7.53			7.83		
5.44			5.74			6.04			6.34			6.64			6.94			7.24			7.54			7.84		
5.45			5.75			6.05			6.35			6.65			6.95			7.25			7.55			7.85		
5.46			5.76			6.06			6.36			6.66			6.96			7.26			7.56			7.86		
5.47			5.77			6.07			6.37			6.67			6.97			7.27			7.57			7.87		
5.48			5.78			6.08			6.38			6.68			6.98			7.28			7.58			7.88		
5.49			5.79			6.09			6.39	1		6.69			6.99			7.29			7.59			7.89		

VITRINITE 0.1%		INERTINITE 0.2%						LIPTINITE -%								OIL DROPS	BITUMEN
TV	DV	Sfus	Scler	Fus	Macr	ID	Micr	Spor	Cut	Sub	Res	Ld	Bituminite	Telalginite	Lamalginite	Oil cut	

Sample Number..L0848...Well Name...South Western,...Hunt USA No.1-1,....GC967-19.1...................................... Depth...15050-15110Ft..... .... SampleType....Ctgs...
Date. ..13/.06/ 2006.. Op..SPR........ FGV - First Generation Vitrinite, RV - Reworked Vitrinite, BTT - Bituminite, B - Bitumen, Inert - Inertinite, Cav - Cavings, DA - Drilling Mud Additives

R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range
5.20			5.50			5.80			6.10	1		6.40	1		6.70			7.00			7.30			7.60					
5.21			5.51			5.81			6.11	1		6.41			6.71			7.01			7.31			7.61					
5.22			5.52			5.82			6.12	2		6.42			6.72			7.02			7.32			7.62					
5.23			5.53			5.83			6.13			6.43			6.73			7.03			7.33			7.63					
5.24			5.54			5.84			6.14			6.44			6.74			7.04			7.34			7.64					
5.25			5.55			5.85			6.15			6.45	1		6.75	1	FGV	7.05			7.35			7.65					
5.26			5.56			5.86			6.16	1		6.46			6.76	1	↓	7.06			7.36			7.66					
5.27			5.57			5.87			6.17	1		6.47			6.77			7.07			7.37			7.67					
5.28			5.58			5.88			6.18			6.48			6.78			7.08			7.38			7.68					
5.29			5.59			5.89			6.19			6.49			6.79			7.09			7.39			7.69					
5.30			5.60			5.90			6.20			6.50			6.80			7.10			7.40			7.70					
5.31			5.61			5.91			6.21			6.51	1		6.81			7.11			7.41			7.71					
5.32			5.62			5.92			6.22			6.52			6.82			7.12			7.42			7.72					
5.33			5.63			5.93			6.23			6.53			6.83			7.13			7.43			7.73					
5.34			5.64			5.94			6.24			6.54			6.84			7.14			7.44			7.74					
5.35			5.65			5.95			6.25			6.55			6.85			7.15			7.45			7.75					
5.36			5.66			5.96			6.26			6.56	1		6.86			7.16			7.46			7.76					
5.37			5.67			5.97			6.27			6.57			6.87			7.17			7.47			7.77					
5.38			5.68			5.98			6.28			6.58			6.88			7.18			7.48			7.78					
5.39			5.69			5.99	1	↑	6.29			6.59			6.89			7.19			7.49			7.79					
5.40			5.70			6.00	1	FGV	6.30	1		6.60			6.90			7.20			7.50			7.80					
5.41			5.71			6.01			6.31			6.61			6.91			7.21			7.51			7.81					
5.42			5.72			6.02			6.32			6.62			6.92			7.22			7.52			7.82					
5.43			5.73			6.03			6.33	1		6.63			6.93			7.23			7.53			7.83					
5.44			5.74			6.04			6.34			6.64			6.94			7.24			7.54			7.84					
5.45			5.75			6.05			6.35			6.65			6.95			7.25			7.55			7.85					
5.46			5.76			6.06			6.36			6.66			6.96			7.26			7.56			7.86					
5.47			5.77			6.07			6.37	1		6.67			6.97			7.27			7.57			7.87					
5.48			5.78			6.08	2		6.38			6.68			6.98			7.28			7.58			7.88					
5.49			5.79			6.09			6.39			6.69			6.99			7.29			7.59			7.89					

VITRINITE 0.3%		INERTINITE 0.4%						LIPTINITE -%								OIL DROPS	BITUMEN
TV	DV	Sfus	Scler	Fus	Macr	ID	Micr	Spor	Cut	Sub	Res	Ld	Bituminite	Telalginite	Lamalginite	Oil	cut

Sample Number..L0849...Well Name...South Western,...Hunt USA No.1-1,....GC967-20.1....................................... Depth...15600-15650Ft..... .... SampleType....Ctgs...
Date. ..13/.06/ 2006.. Op..SPR........ FGV - First Generation Vitrinite, RV - Reworked Vitrinite, BTT - Bituminite, B - Bitumen, Inert - Inertinite, Cav - Cavings, DA - Drilling Mud Additives MICR D:\RWORK.ms6\967VRW06.doc

R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range
5.20			5.50			5.80			6.10			6.40	1		6.70			7.00			7.30			7.60		
5.21			5.51			5.81			6.11			6.41			6.71			7.01			7.31			7.61		
5.22			5.52			5.82			6.12			6.42			6.72			7.02			7.32		FGV	7.62		
5.23			5.53			5.83			6.13	1		6.43			6.73			7.03			7.33	1	↓	7.63		
5.24			5.54			5.84			6.14			6.44			6.74			7.04			7.34			7.64		
5.25			5.55			5.85			6.15			6.45	1		6.75			7.05			7.35			7.65		
5.26			5.56			5.86			6.16			6.46			6.76			7.06			7.36			7.66		
5.27			5.57			5.87			6.17			6.47			6.77			7.07			7.37			7.67		
5.28			5.58			5.88			6.18			6.48	1		6.78			7.08			7.38			7.68		
5.29			5.59			5.89			6.19			6.49			6.79			7.09			7.39			7.69		
5.30			5.60			5.90			6.20			6.50			6.80			7.10			7.40			7.70		
5.31			5.61			5.91			6.21			6.51			6.81			7.11			7.41			7.71		
5.32			5.62			5.92			6.22	1		6.52			6.82			7.12			7.42			7.72		
5.33			5.63			5.93			6.23			6.53			6.83			7.13			7.43			7.73		
5.34			5.64			5.94			6.24	1		6.54			6.84			7.14			7.44			7.74		
5.35			5.65			5.95			6.25			6.55			6.85			7.15			7.45			7.75		
5.36			5.66			5.96			6.26			6.56			6.86			7.16			7.46			7.76		
5.37			5.67			5.97			6.27			6.57			6.87			7.17			7.47			7.77		
5.38			5.68			5.98			6.28	1		6.58			6.88			7.18			7.48			7.78		
5.39			5.69			5.99			6.29			6.59			6.89			7.19			7.49			7.79		
5.40			5.70			6.00			6.30	1		6.60			6.90			7.20			7.50			7.80		
5.41			5.71			6.01			6.31			6.61			6.91			7.21			7.51			7.81		
5.42			5.72			6.02			6.32			6.62			6.92			7.22			7.52			7.82		
5.43			5.73			6.03			6.33	1		6.63			6.93			7.23			7.53			7.83		
5.44			5.74			6.04			6.34			6.64			6.94			7.24			7.54			7.84		
5.45			5.75			6.05			6.35			6.65			6.95			7.25			7.55			7.85		
5.46			5.76			6.06			6.36			6.66			6.96			7.26			7.56			7.86		
5.47			5.77			6.07			6.37			6.67			6.97			7.27			7.57			7.87		
5.48			5.78			6.08			6.38	1		6.68			6.98			7.28			7.58			7.88		
5.49			5.79			6.09	1	↑	6.39			6.69			6.99	1		7.29			7.59			7.89		

VITRINITE 0..3%		INERTINITE 0.1%						LIPTINITE -%								OIL DROPS	BITUMEN
TV	DV	Sfus	Scler	Fus	Macr	ID	Micr	Spor	Cut	Sub	Res	Ld	Bituminite	Telalginite	Lamalginite	Oil cut	

Sample Number..L0850...Well Name...South Western,...Hunt USA No.1-1,....GC967-21.1...................................... Depth..16270-16300Ft..... .... SampleType....Ctgs...
Date. ..17/.06/ 2006.. Op..SPR........ FGV - First Generation Vitrinite, RV - Reworked Vitrinite, BTT - Bituminite, B - Bitumen, Inert - Inertinite, Cav - Cavings, DA - Drilling Mud Additives

R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range
5.20			5.50			5.80			6.10			6.40			6.70			7.00			7.30			7.60		
5.21			5.51			5.81			6.11			6.41	1		6.71			7.01			7.31			7.61		
5.22			5.52			5.82			6.12			6.42			6.72			7.02			7.32			7.62		
5.23			5.53			5.83			6.13	1	↑	6.43			6.73			7.03			7.33			7.63		
5.24			5.54			5.84			6.14		FGV	6.44	1		6.74			7.04			7.34			7.64		
5.25			5.55			5.85			6.15			6.45	2		6.75			7.05			7.35			7.65		
5.26			5.56			5.86			6.16			6.46			6.76			7.06			7.36			7.66		
5.27			5.57			5.87			6.17	1		6.47			6.77			7.07			7.37			7.67		
5.28			5.58			5.88			6.18			6.48			6.78			7.08			7.38			7.68		
5.29			5.59			5.89			6.19			6.49	1		6.79			7.09			7.39			7.69		
5.30			5.60			5.90			6.20			6.50			6.80			7.10			7.40			7.70		
5.31			5.61			5.91			6.21			6.51			6.81			7.11			7.41			7.71		
5.32			5.62			5.92			6.22			6.52			6.82			7.12			7.42			7.72		
5.33			5.63			5.93			6.23			6.53			6.83	1		7.13			7.43			7.73		
5.34			5.64			5.94			6.24			6.54			6.84			7.14			7.44			7.74		
5.35			5.65			5.95			6.25			6.55	1		6.85			7.15			7.45			7.75		
5.36			5.66			5.96			6.26			6.56	1		6.86			7.16			7.46			7.76		
5.37			5.67			5.97			6.27			6.57			6.87			7.17		FGV	7.47			7.77		
5.38			5.68			5.98			6.28			6.58			6.88			7.18	1	↓	7.48			7.78		
5.39			5.69			5.99			6.29	1		6.59	1		6.89			7.19			7.49			7.79		
5.40			5.70			6.00			6.30	1		6.60			6.90			7.20			7.50			7.80		
5.41			5.71			6.01			6.31	1		6.61	1		6.91			7.21			7.51			7.81		
5.42			5.72			6.02			6.32	1		6.62	1		6.92			7.22			7.52			7.82		
5.43			5.73			6.03			6.33			6.63			6.93			7.23			7.53			7.83		
5.44			5.74			6.04			6.34			6.64			6.94			7.24			7.54			7.84		
5.45			5.75			6.05			6.35	1		6.65	1		6.95			7.25			7.55			7.85		
5.46			5.76			6.06			6.36			6.66	1		6.96			7.26			7.56			7.86		
5.47			5.77			6.07			6.37			6.67	2		6.97			7.27			7.57			7.87		
5.48			5.78			6.08			6.38			6.68			6.98			7.28			7.58			7.88		
5.49			5.79			6.09			6.39	2		6.69			6.99			7.29			7.59			7.89		

VITRINITE 0.4%		INERTINITE <0.1%						LIPTINITE -%								OIL DROPS	BITUMEN
TV	DV	Sfus	Scler	Fus	Macr	ID	Micr	Spor	Cut	Sub	Res	Ld	Bituminite	Telalginite	Lamalginite	Oil cut	

Sample Number..L08501..Well Name...South Western,...Hunt USA No.1-1,....GC967-22.1...................................... Depth..16630-16670Ft..... .... SampleType....Ctgs...
Date. ..17/.06/ 2006.. Op..SPR........ FGV - First Generation Vitrinite, RV - Reworked Vitrinite, BTT - Bituminite, B - Bitumen, Inert - Inertinite, Cav - Cavings, DA - Drilling Mud Additives

Appendix 4. Production Data of Representative Gas Wells Located in the Waveland Gas Field, Arkansas.

Well Name	API No.	Filed Name	Location	County	State
Steward, Billy No. 5-17	03-149-10143	Waveland	Sec.17, T5N, R24W	Yell	AR
Caldwell No. 1-12	03-149-10138	Waveland	Sec.12, T5N, R25W	Yell	AR
Palmer tree No. 9-12	03-149-10134	Waveland	Sec.12, T5N, R25W	Yell	AR

Well Name	Test Time	Initial Production Rate	Cumulative Production	Current Status
Steward, Billy No. 5-17	4/26/2007	Del 1,800 mcf, AOF N/A	31,681 mcf (05/07 – 06/07)	Active
Caldwell No. 1-12	3/13/2006	Del 2,283 mcf, AOF 2,574 mcf	134,904 mcf (03/06 – 06/07)	Active
Palmer tree No. 9-12	10/18/2005	Del 520 mcf, AOF 542 mcf	7,766 mcf (10/05 – 06/07)	Active

*** Data provided by Arkansas Oil and Gas Commission**