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USE OF "ROCK-TYPING" TO CHARACTERIZE CARBONATE
RESERVOIR HETEROGENEITY

Final Report

By
Killian C. Ikwuakor

March 1994

Performed Under Contract No. DE-AC22-91BC14655

Ikwuakolam Energy Company, Inc.
Denver, Colorado

**Bartlesville Project Office
U. S. DEPARTMENT OF ENERGY
Bartlesville, Oklahoma**

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1. Stratigraphic cross-sections in the N-S and E-W directions *

*This plate is available on request from the Office of Scientific and Technical Information, P.O. Box 62, Oak Ridge, Tennessee 37831 for the price of copying. Phone (615) 576-8401 for prices.

ABSTRACT

The objective of the project was to apply techniques of "rock-typing" and quantitative formation evaluation to borehole measurements in order to identify reservoir and non-reservoir rock-types and their properties within the "C" zone of the Ordovician Red River carbonates in the northeast Montana and northwest North Dakota areas of the Williston Basin. Rock-typing discriminates rock units according to their pore-size distribution. Formation evaluation estimates porosities and pore fluid saturation.

Rock-types were discriminated using crossplots involving three rock-typing criteria: (1) linear relationship between bulk density and porosity, (2) linear relationship between acoustic interval transit-time and porosity, and (3) linear relationship between acoustic interval transit-time and bulk density. Each rock-type was quantitatively characterized by the slopes and intercepts established for different crossplots involving the above variables, as well as porosities and fluid saturations associated with the rock-types. Another family of linear relationships involving shear wave velocity, compressional wave velocity, and porosity were used to characterize the entire "C" zone carbonate section. Slopes and intercepts derived in the combined use of shear and compressional wave velocities are characteristic of carbonates, and corroborate results predicted from other studies.

The "C" zone of the Red River carbonates is extremely heterogenous. The heterogeneities were observed in hand specimen, and corroborated by wide variabilities in porosity, permeability, grain density, the porosity-permeability crossplot, and the results from rock-typing and quantitative formation evaluation.

Sixty-four different rock-types were identified in the fifty-two wells studied. Vertical distribution of rock-types shows a non-porous anhydrite rock-type, underlain, in most wells, by combinations of anhydritic dolomite and dolomite rock-types. These in turn are underlain by dolomitic limestone and limestone rock-types. In a few cases, dolomitic limestone rock-types directly underlie the anhydrite rock-type. The anhydritic dolomite and dolomite rock-types are either porous or non-porous, and in some wells interlayered with dolomitic limestone and limestone rock-types. Dolomitic limestone and limestone rock-types are generally non-porous or have low porosities. The thickness of the non-porous dolomite rock-types varies from a few feet in some wells to over hundred feet in others.

Except for the anhydrite rock-type that is present in all the wells, lateral distribution of rock-types is difficult to correlate, in part because of the wide separation between wells used in the study, and in part because rock-types change rapidly even in wells that are closely spaced.

The occurrence of both porous and non-porous dolomite rock-types, the random variation of their thickness, and the interlayering of these rock-types with limestone and dolomitic limestone rock-types are indicative of complex depositional environments for the "C" zone. Development of depositional models that would satisfy all of these conditions is beyond the scope of this study.

All the existing production was confirmed through quantitative formation evaluation. Several potential productive zones were bypassed in both producing wells and those designated plugged-and-abandoned.

Highly porous dolomites and anhydritic dolomites contribute most of the production, and constitute the best reservoir rock-types. Dolomitic limestones and limestones make up the bulk of the untested and/or by-passed reserves. If all the bypassed zones proved correct, they represent approximately 150 million barrels of oil-in-place.

Forty-six of the sixty-four rock-types identified developed oil reservoir characteristics in one or more of the fifty-two wells studied. Commonly, rock-types that were calculated to have pessimistic water saturations or lacked good porosity in one well, developed good porosities or produced oil in other wells. This observation indicates that the presence of oil was not an important factor in the discrimination of rock-types. Only twenty-six of the forty-six reservoir rock-types occur in perforated intervals. The rest were bypassed. In a few cases, all the oil produced came from a single rock-type, thus confirming the reservoir quality of the particular rock-type. In most other cases, more than one rock-type was contained in the perforated and producing interval, leading one to guess as to which rock-types were productive.

The process of quantitative formation evaluation developed in this study proved consistent in identifying proven reserves. It could become the much needed approach for evaluating the Red River carbonates to determine fluid saturations and identify bypassed reserves.

The results of this study can be applied in field development and in-fill drilling. Potential targets would be areas of porosity pinchouts and those areas where highly porous zones are downdip from non-porous and tight dolomites. Such areas are abundant. In order to model reservoirs for enhanced oil recovery (EOR) operations, a more localized (e.g. field scale) study, expanded to involve other rock-typing criteria, is necessary.

EXECUTIVE SUMMARY

Information on geological characteristics that have been accumulated over the years for the Ordovician Red River carbonates make these carbonates a perfect target for study of reservoir heterogeneity. The Red River "C" zone, the subject of the study, is the oldest of three depositional cycles, the thickest and, economically, most significant. A successful study would open up the Red River reservoirs to additional development and infill drilling, and the reservoirs could become targets for enhanced oil recovery (EOR) operations.

Pertinent well logs, as well as laboratory core measurements from a key well, were gathered in order to study lithologic heterogeneity and associated petrophysical properties and fluid distributions within the "C" zone of the Red River formation. Core measurements were used to obtain important rock-typing parameters.

Most Red River wells are located on structural crests, although production has also been found around the flanks of structures. Production is associated with dolomitization, even though production has been known to occur where relative dolomitization is the least. Permeability is also unpredictable, and pore throat connection is usually poor even for wells located in favorable structural positions. These problems show that reservoir distribution is not well understood, and that oil accumulation is, at least, in part stratigraphically controlled.

Potential for bypassed reserves exists, in part because of the unresolved complexity of the Red River carbonate reservoirs, and in part because no systematic or reliable log analysis procedure has heretofore been developed for the Red River reservoirs.

The problems experienced in the Red River reservoirs are related to pore-size distribution. Ikwakolam Energy Company (IEC) has applied the concept of "rock-type" towards understanding these problems. The rock-typing techniques used are mostly quantitative, and derive their effectiveness through the integration of rock property measurements, such as velocity, porosity and density. These measurements, independently, are inadequate for interpreting geology. The expertise of geologists and petrophysicists were engaged in this effort.

Slight changes in rock property measurements can affect the results of rock-typing and formation evaluation. It was for this reason that quality control checks were conducted on the well logs used, and appropriate corrections applied. Resistivity logs, for example, were found to read too high in several wells. If uncorrected, calculated water saturation would be too optimistic, and cause drilling of unnecessary wells.

A total of sixty-four different rock-types were identified in the fifty-two wells studied. The average for each well is eighteen rock-types. The vertical distribution of major

lithologic types generally shows anhydrite underlain by dolomites which, in turn, are underlain by limestones. However, the vertical distribution of the rock-types in each well is not as easily predicted.

Widespread tight anhydrite rock-type tops the Red River "C" zone. It is generally underlain by dolomite and anhydritic dolomite rock-types. The dolomite and anhydritic rock-types are porous in some wells and tight (so-called cryptocrystalline) in others. The thickness of these rock-types varies widely from a few feet in some wells to over a hundred feet in others. Distribution of porous and tight dolomites is random. What is most surprising is the occurrence in some wells of thick dolomites underlying limestone and dolomitic limestone rock-types. In a few wells, the anhydrite rock-type is directly underlain by dolomitic limestone rock-types. Otherwise, limestone and dolomitic limestone rock-types are generally at the bottom of the carbonate sequence, and have low porosities.

Lateral distribution of rock-types is even more abrupt, hence the potential for stratigraphically trapped oil, and the need to reexamine the present 640-acre spacing for Red River wells in the study area. Except for anhydrite, correlation of rock-types cannot be made with certainty.

The development of a consistent formation evaluation process is one of the highlights of this study. Corrected log values were applied into the traditional Archie's equation to determine water saturation. A graphical technique, the so-called "Pickett-plot," was used to facilitate calculation of water saturation.

Rock-types that are tight in one location, commonly develop good porosities in other wells. This observation is critical in understanding results from quantitative formation evaluation. Of the sixty-four different rock-types identified, forty-six calculated favorable water saturation (not greater than 50%) in one or more wells. This high number is the result of non-reservoir rock-types in some wells developing reservoir characteristics in other wells. Pore fluid, apparently, was not a major factor in differentiating rock-types. We were limited by the regional scope of the study and by the paucity of closely spaced wells; it was not possible to observe the progression of these rock-types from non-reservoir conditions to reservoir quality. Also in some wells, the same rock-type or different rock-types at widely separated depth intervals produced oil or calculated favorable water saturations. This implies the occurrence of multiple oil/water contacts.

All the producing zones in the different wells were confirmed. It was therefore concluded that the zones that calculated favorable water saturation but were not produced, may represent bypassed reserves. The bypassed reserves are estimated at 150 million barrels of oil-in-place, based on a 640-acre drainage area. This estimate may be high because it includes zones with marginal water saturation close to 50%. The marginal

zones would be eliminated if higher formation water resistivity measured in some wells were used to calculate water saturation rather than the value of 0.018 ohm-m used in the study. Most of the bypassed zones are low porosity limestone and dolomitic limestone rock-types. If these contain oil at all, they would require reservoir enhancement treatment in order to produce.

Most of the production comes from porous anhydritic dolomite and dolomite rock-types. Those rock-types that had the best combination of high porosity and low water saturation were regarded as the best reservoirs. This grading provided the opportunity to identify the two best reservoir rock-types. These two would be important targets for enhanced oil recovery projects.

The Red River "C" zone carbonates are extremely heterogenous. The heterogeneity is manifested in the wide variability and distribution of lithologic types and rock-types, in porosity and permeability variations, in pore fluid composition and distribution, and in the depositional and diagenetic conditions that caused the above variations.

Because of these complexities, and because of what we believe was an equally complex structural history during the deposition of the Red River "C" zone, it is premature at this time to suggest any reasonable geologic models that would satisfy the results of this study. Further studies will be needed.

This project is regional in character. Only fifty-two out of approximately 150 Red River wells in the study area were studied. Also, only three out of eight rock-typing criteria were used. Interwell heterogeneities and relationships, for example, would be better established and predicted if all the 150 wells were used in the study. The fact that the second and third elements in the 3-element code system for differentiating and naming rock-types could not be sufficiently interpreted, stresses the need to integrate other rock-typing criteria, as well as incorporate other geologic reservoir characterization techniques. Such integration would benefit field scale studies for reservoir simulations and EOR pilot projects.

Despite some limitations, the results of this study provide opportunities for satisfying some of DOE's enhanced oil recovery (EOR) objectives. Additional development and infill drilling will be effective in those areas where permeability barriers, created by low porosity and tight zones, lie updip of porous zones. The study also provides processes that can be used to identify bypassed reserves in carbonate reservoirs, and isolate the most favorable reservoir rock-types for EOR pilot projects.

CHAPTER 1 - INTRODUCTION

Objectives of the Project

The objective of the research was to apply techniques of "rock-typing" and quantitative formation evaluation to borehole measurements in order to identify reservoir and non-reservoir rock types and their properties within the "C" zone of the Ordovician Red River carbonates in the northeast Montana and northwest North Dakota areas of the Williston Basin. "Rock-typing" discriminates, and may also grade rock units according to their pore-size distribution and, sometimes, pore saturant.

Key tasks were performed toward achieving the objective. Review of pertinent literature was done in order to understand and increase geological knowledge of the Red River formation, including the depositional models. Data acquisition had two main objectives: 1) to gather commonly used well logs that have similar logging parameters, and 2) to access rock section cored through the "C" zone of the Red River formation. The cored rock was then used to visually observe and describe rock heterogeneity in hand specimen, and later to measure rock properties of interest.

Because the "rock-typing" process is sensitive to changes in porosity, and results of quantitative formation evaluation are affected by erroneous well logs, quality control checks were made on the logs to identify measurement problems. Quality control assures that analytical results are of adequate accuracy.

Continuous zonation and correlation of common zones in all well logs used were conducted in each well studied. Each zone could then be independently recognized and quantitatively characterized. Identification of all rock-types present and grading of reservoir-quality rock-types were accomplished through a system of linear-linear crossplots involving bulk density, acoustic interval transit-time, porosity, and water saturation. Depositional facies and their vertical distributions were also identified in the process.

Water saturations were determined through log-log crossplots between porosity and formation resistivity. Production data was integrated for confirmation of producing zones, identification of reservoir-quality rock-types, and determination of bypassed reserves.

All the efforts mentioned above have led to the determination of the vertical relationships (to a lesser degree, due to the regional scope of the study, the lateral relationships) of the "C" zone carbonate rock-types, their distribution and associated depositional facies, as well as the porosities, fluid saturations, fluid distributions, and the rock-typing parameters associated with the rock-types. Some of these properties could be helpful in modeling the carbonates for enhanced oil recovery. Opportunities exist for additional development and in-fill drilling, and more detailed exploration.

Reservoir Heterogeneity and Characterization

Results from field development operations have exposed many problems regarding our understanding of oil and gas reservoirs. For example, the wide variability of initial flow potentials, the erroneous predictions of recovery from enhanced oil recovery (EOR) projects, and the often erroneous predictions of hydrocarbon-in-place or recoverable hydrocarbon are all indicative of complex reservoir environments.

Specifically, for the "C" zone Red River carbonates, most of the wells are located on structural crests. However, often, the porous zone that produces in one well or area disappears, only to be replaced by entirely different porous productive zones. This suggests the need for proper understanding of the reservoir rock distribution.

Most of the production is associated with dolomitization, even though production has been known to occur where relative dolomite occurrence is the least (Kohm and Loudon, 1978). Kohm and Loudon also showed that large dolomite grain size did not necessarily translate to better production; most production had come from reservoir rock with smaller-grained dolomite. This suggests the existence of non-dolomite reservoirs, and that oil accumulation is partially stratigraphic. The partially stratigraphic setting for some reservoirs is also supported by the fact that, in some fields, production from the "C" zone has been found around the flanks rather than the crest of the structures (Kendall, 1976).

Pore throat connection has not improved for wells located in favorable structural positions. These observations prove that grain contact area and not grain size is more significant for permeability to oil.

Furthermore, no systematic log analysis procedure has been developed. Most operators look for "shows" and conduct Drill Stem Tests (DST) only in intervals where "shows" occur or in high porosity intervals. Many bypassed reservoirs, possibly, exist.

All the observations listed above reflect geological heterogeneities within the "C" zone Red River carbonates. The heterogeneities are, primarily, the direct imprint of the environments of carbonate deposition, together with diagenetic change, structural history and fluid distribution. These, in turn, control the internal architecture and composition of the reservoirs, and are embedded in the reservoir physical properties. Their interpretation is possible only through the integration and analysis of rock property measurements.

It was with the above concept in mind that we have applied the innovative concept of "rock-type" and the "rock-typing" process towards identifying and quantifying aspects of heterogeneity within the "C" zone of the Ordovician Red River carbonates.

Definition of Rock-Typing

Experience gained through petrophysical investigation of geological sections has repeatedly shown that the rocks comprising such sections are usually divisible into groups, each group being characterized by a different set of properties and/or relations between properties. For such groups, the name "rock type" is applied (Pickett, 1972). "Rock-typing" is the process of identifying rock-types from borehole measurements. The process is mostly quantitative, as opposed to petrographic and lithofacie interpretations from well logs made with reference to the character or curves on logs.

For example, in the "C" zone Red River carbonate section, limestone, dolomite, anhydritic dolomite and anhydrite are present. Each was segregated through a petrophysical relationship used in the study. Therefore, limestone, dolomite, anhydritic dolomite and anhydrite, each represents a different rock-type.

For the purposes of this study, the above named rock-types represent just one facet of definition of rock-type. This is because the rock-types could be recognized simply by applying one of several petrophysical relationships. Refinement of the rock-type requires the application of other petrophysical relationships.

Essentially, rock-types reflect different pore-size distributions. Commonly used criteria for rock-typing in the exploration and development of petroleum resources are listed below:

1. lithology (sandstone, limestone, dolomite, etc.).
2. permeability to fluid and porosity relationship.
3. relationship between porosity and porosity log response (acoustic, neutron, density).
4. relationship between initial and residual hydrocarbon saturation.
5. capillary pressure curve shape (pore size distribution).
6. relationship between water saturation and porosity
7. "cementation" and "saturation" exponents ("m" and "n").
8. Recent studies have shown that a family of relationships between compressional and shear wave velocities can be used for rock-typing (Ikwuakor, 1988).

The concept of rock-type is fundamentally important in oil reservoir characterization because experience has shown that, usually, only one or two rock-types in a given formation will contribute the bulk of fluid production from hydrocarbon-bearing reservoirs. Ability to identify and define the favorable rock-types will, undoubtedly, focus attention to these rock-types, cut down the amount of data to be analyzed, and optimize production and EOR processes. A favorable rock-type can therefore be regarded as the one that has the best combination of porosity, permeability, texture and pore-size distribution necessary to contribute the bulk of oil production.

Rock-typing is possible because the measured rock properties are interrelated (Pickett and Ikwaakor, 1979; Ikwaakor, 1980). The interrelationship between rock properties is basically a reflection of the interdependence of geological properties or parameters (e.g., lithology, grain size and grain size distribution, pore-size distribution, cementation, etc.) (Bedwell, 1974). For example, pore-size distribution affects not only the capillary pressure curve shape, but also the water saturation-porosity relationship, cementation exponent (m), saturation exponent (n), the residual - initial hydrocarbon saturation relationship, the porosity log - porosity relationship, and the permeability - porosity relationship.

Textural properties of a rock are correlatable with depositional environments (Bedwell, 1974). Since rock-types reflect depositional, post depositional and diagenetic characteristics, rock-typing, in certain cases, may serve the dual purpose of identifying rock-types as well as depositional environments.

Study Area

The study area is located in the Williston Basin within T31N to T34N, R56E to R59E, Sheridan County, northeast Montana, and T158N to T160N, R102W to R103W, Williams and Divide Counties, northwest North Dakota (Figure 1). Fields in Montana include the Reserve, Dwyer, Medicine Lake, Kathy Lake, Clear Lake, Brush Lake, Dagmar, Rush Mountain, and Divide (not all produce from the Red River formation). Fields in North Dakota include the Grenora, Hanks, and Bar Butte fields. Altogether, the study area represents a land area of approximately 630 square miles.

A total of 52 wells were studied from over 150 wells that penetrate the Red River "C" zone. The scope of this study is therefore considered regional.

STUDY AREA

FIGURE 1

CHAPTER 2 - GEOLOGY/RESERVOIR DESCRIPTION

Stratigraphy

The Red River Formation (Ordovician) consists of three major sequences or zones designated, from the youngest to oldest, "A," "B" and "C." The zones are separated by layers of anhydrite. The "C" zone, the thickest and economically most significant, is the subject of the study (Figure 2).

For the purposes of this report, we will adopt the stratigraphic nomenclature of Kohm and Loudon(1978).

The "C" zone is considered to be a "shallowing-upward" sequence (Carroll, 1978) or a "brining-upward" subtidal sequence (Kohm and Loudon, 1978; Longman, Fertal, and Glennie, 1983). These two depositional models are equally supported by the same characteristic lithologic types, in descending order (Longman, Fertal, and Glennie, 1983):

1. Anhydrites: "C" Anhydrite Member
2. Dolomites: "C" Laminated Member
3. Limestones: "C" Burrowed Member

The "C" Anhydrite Member is generally bedded, nodular in places, and laterally persistent throughout most of the Williston Basin. It is believed to have been deposited as a restricted basin wide "marine playa" or formed subtidally under hypersaline conditions (Longman, Fertal, and Glennie, 1983).

The "C" Laminated Member consists of laminated dolomites. Its contact with the overlying "C" Anhydrite Member is sharp, although anhydritic dolomite may occur in places in the uppermost part of the "C" Laminated Member. The unit is persistent, almost uniformly thick and can be correlated across the basin. The Gamma-Ray log response is generally higher and easily distinguishable from the uniform "clean" log characters of the overlying "C" Anhydrite Member and the underlying "C" Burrowed Member. In hand specimen, the laminations are thin color bands which proponents of the "shallowing-upward" (sabkha) depositional model have called "stromatolitic" as evidence to support their model. Proponents of the "brining-upward" model describe the laminated carbonates as the product of inorganic subtidal processes (Kohm and Loudon, 1978). Fossils are rare in the Laminated Member.

The "C" Burrowed Member is characterized by abundant burrows. The limestones are highly fossiliferous and, in places, interbedded with dolomites. It is believed the burrows may have played a significant role in controlling dolomitization, possibly acting as permeable conduits for dolomitizing fluids (Longman, Fertal, and Glennie, 1983). Within the burrowed member are thin

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Figure 2. Typical Compensated Neutron-Density log of the Ordovician Red River Formation in the study area, annotated with lithostratigraphic nomenclature used in this report.

marker beds of black kerogenite, usually two to six feet thick, that can be correlated across much of the basin. These may be the source of Red River hydrocarbon (Kohm and Loudon, 1978).

Depositional Models

Two major depositional models that can equally explain the Red River "C" zone depositional characteristics have existed side by side through the years: the "shallowing-upward" (Sabkha) model (Carroll, 1978; Asquith, Parker, Gibson, and Root, 1978) and the "brining-upward" subtidal model (Kohm and Loudon, 1978; Kendall, 1976; Longman, Fertal, and Glennie, 1983).

In the shallowing-upward model, depth of (marine) water is the controlling factor. Limestone, dolomite and anhydrite are deposited in deeper subtidal, intertidal and supratidal environments, respectively. Modern carbonate sedimentation, especially in arid climates, tends to support this model. For example, in arid climates, anhydrite usually caps the cycle.

In the brining-upward subtidal model, on the other hand, increasing salinity is considered the major control of depositional fabrics. The strongest evidence in support of the upward-brining subtidal cycle is the following (Longman, Fertal, and Glennie):

1. the blanket-like geometry of the "C" Laminated Member across the whole basin.
2. the absence of anhydrite at the basin edges where, normally, anhydrite should form in a shallowing-upward cycle.
3. the blanket-like nature of the "C" anhydrite across the basin's paleocenter.
4. the absence of sabkha characteristics such as mudcracks, abrupt facies changes, rip-up clasts, and exposure surfaces in the "C" Laminated Member.

Using the brining-upward model, Longman, et al. presented a model for the formation and distribution of dolomites in the Red River "C" zone (Figure 3). If this model is proven correct, it will be useful in predicting the lateral distribution of rock-types, in selecting areas for detailed exploration, and in locating in-fill drilling and development wells.

They recognized three major types of dolomites: 1) tight cryptocrystalline dolomites (porosity less than three percent) which always occurred below the "C" Anhydrite in the "C" Laminated Member, 2) porous dolomites that form the "C" zone reservoirs, and lie beneath and adjacent to the cryptocrystalline dolomites, and 3) partially dolomitized limestones that lie beneath and laterally adjacent to the porous dolomites.

Figure 3. Dolomitization model and cross-section of idealized reservoir formed by Red River "C" zone dolomite lenses.
(After Longman, Fertal, and Glennie, 1983).

Longman, et al. also concluded that dolomites were formed by downward migration of magnesium-rich brines generated by precipitation of the subtidal anhydrite, and that the brines migrated through "holes" in the anhydrite. Cryptocrystalline dolomites were formed where the magnesium-rich brines first entered the underlying carbonate sediments. As the brines migrated away from the "holes," diluted, they formed porous dolomites and, still farther away, partially dolomitized limestones. Interfingering limestones and dolomites formed because of differential initial permeabilities of some of the rock units.

Today, while the formation of "C" anhydrites and the dolomites are still considered subtidal by the proponents of the upward-brining depositional model, the mode of migration of the dolomitizing brines is no longer considered plausible. Thomas Fertal, co-author in Longman et. al., now considers the different dolomitizations (cryptocrystalline, porous and partial) the result of stratified brine being in contact with paleohighs on the sea floor (personal communication). Cryptocrystalline dolomite, for example, would form where highly concentrated magnesium-rich brine was in contact with paleohighs; less potent brines would form porous dolomites.

Data Selection for the Study

A total of 52 wells were selected for the study (50 wells were proposed) from over 150 wells that penetrate the Red River "C" zone. Forty-one of these wells are located in Montana, and only eleven that penetrated the "C" zone were found in North Dakota.

Well logs and production data were obtained from the Denver Earth Resources Library. Well selection was made on the following criteria: 1) sufficient penetration into the "C" zone to allow identification of the three members, 2) availability of a pertinent suite of logs; BHC Sonic, Compensated Neutron-Density, and Resistivity (deep and shallow), 3) quality of the logs, 4) uniformity of logging parameters; matrix density 2.71 gm/cc, fluid density 1.1 gm/cc, matrix interval transit-time 47.6 usec/ft. and, 5) position of the well in relation to possible lines of cross-section. Table 1 is a listing of the wells.

Production comes from both the "C" laminated and the burrowed zones, but rarely together in the same well. Dolomites and anhydritic dolomites produce most of the oil. Initial flow potentials range from less than 100 BOPD to over 1500 BOPD.

The Key Well is the Chevron Melby #4-1 well, located in NSW Sec.1 T33N R58E, Sheridan County, Montana. This well was chosen as the key well mainly on the availability of an adequate cored section in the Red River "C" zone; otherwise its logs are of poor quality. The cores were located at the USGS Core Repository, Federal Center, Denver, Colorado. Core analysis and other well data were obtained from Chevron USA, Inc., the Denver

Table 1. List of wells used in the study.

No.	Well Name	Location	County	IP/Day
1	Anderson #1	sene 9-32N-56E	Sheridan/MT	200 BO 156 MCFG 14 BW
2	Francis Lars. #1	nenw 10-32N-56E	Sheridan/MT	D&A
3	NW Natl. L. #31-12	nwne 12-32N-56E	Sheridan/MT	D&A
4	Ator #2	nese 21-32N-56E	Sheridan/MT	D&A
5	Tronson #1	nenw 27-32N-56E	Sheridan/MT	Interl.
6	FLB Peterson #1	sw/4 1-32N-57E	Sheridan/MT	883 BO 687 MCFG
7	Marie Str. #1-2-4C	sesw 2-32N-57E	Sheridan/MT	D&A
8	Fernyhough-W #32-7	swne 7-32N-57E	Sheridan/MT	684 BO 416 MCFG
9	Tronson #1-8	swnw 8-32N-57E	Sheridan/MT	245 BO 174 MCFG 23 BW
10	Stevens SR 1-10-2B	nene 10-32N-57E	Sheridan/MT	TA
11	Stromberg #1	nenw 11-32N-57E	Sheridan/MT	1161 BO 1023 MCFG
12	Federal-Str. #1	nwne 14-32N-57E	Sheridan/MT	Ratcl.
13	Olson #1-20	sw/4 20-32N-57E	Sheridan/MT	322 BO 256 MCFG
14	Cartwright #1-25	senw 25-32N-57E	Sheridan/MT	D&A
15	Siggard #1	nwne 2-32N-58E	Sheridan/MT	251 BO 183 MCFG 3 BW
16	Christensen #1	swne 3-32N-58E	Sheridan/MT	D&A
17	NYBY #1-6	nese 6-32N-58E	Sheridan/MT	225 BO 132 MCFG 10 BW
18	Christensen #1	sesw 12-32N-58E	Sheridan/MT	Ratcl.
19	Rasmussen #13-2	nwne 13-32N-58E	Sheridan/MT	Charls.
20	Willie Bee #2	swne 24-32N-58E	Sheridan/MT	478 BO 287 MCFG 96 BW
21	Union Mortg. #1-29	nese 29-32N-58E	Sheridan/MY	191 BO 383 BW
22	Bagaason #1-9	sese 9-32N-59E	Sheridan/MT	M/C
23	Maline Eidness #1	sww 6-33N-56E	Sheridan/MT	D&A
24	Vera St. #1-21-3C	sese 21-33N-56E	Sheridan/MT	Interl.
25	Holmgaard #1-27	sesw 27-33N-56E	Sheridan/MT	D&A
26	Williams #1-34	sesw 34-33N-56E	Sheridan/MT	939 BO 700 MCFG
27	Sun Sundsted #1	nenw 6-33N-57E	Sheridan/MT	334 BO 411 MCFG 55 BW
28	Astrup #1	swnw 11-33N-57E	Sheridan/MT	D&A
29	Madsen #1-17	swnw 17-33N-57E	Sheridan/MT	D&A
30	Groskurth P. #1-21	swnw 21-33N-57E	Sheridan/MT	479 BO 400 MCFG
31	Patrick-W-G.M #2	nwse 28-33N-57E	Sheridan/MT	168 BO

Table 1. List of wells used in the study (cont.).

32**	Melby #4-1	nws	1-33N-58E	Sheridan/MT	679 BO
33	Clear Lake #1-5	nwnw	5-33N-58E	Sheridan/MT	120 BO
					59 MCFG
34	Guenther #2-8	swne	8-33N-58E	Sheridan/MT	188 BO
					110 BW
35	PPC-Aminoil #1 G-A	nese	17-33N-58E	Sheridan/MT	1529 BO
36	Sampson #1-21	nwse	21-33N-58E	Sheridan/MT	Ratcl.
37	Arneklev #1	nw/4	5-34N-56E	Sheridan/MT	20 BO
					180 BW
38	Josie Larsh #14-1	sene	14-34N-56E	Sheridan/MT	284 BO
					306 MCFG
					5 BW
39	Johansen et al #1	nwse	25-34N-56E	Sheridan/MT	66 BO
					200 MCFG
					53 BW
40	Nettie O. #1-28-1B	nenw	28-34N-56E	Sheridan/MT	D&A
41	Christianson #1-A	sesw	15-34N-57E	Sheridan/MT	107 BO
42	Christensen #1	swnw	22-34N-57E	Sheridan/MT	274 BO
43	Haaven #1-25	nw/4	25-34N-58E	Sheridan/MT	112 BO
					109 MCFG
44	Morken #1	swne	27-34N-58E	Sheridan/MT	Ratcl.
45	Harshbarger #5-29	swnw	29-34N-58E	Sheridan/MT	Ratcl.
46	Ross #11-3	nesw	3-158N-102W	Williams/ND	P&A
47	E. Mitchell #11-21	nesw	21-158N-102W	Williams/ND	P&A
48	l Pasternak #33-13	nws	33-158N-102W	Williams/ND	TA
49	T.M. Tribal #4-1	swse	4-158N-103W	Williams/ND	123 BO
					129 MCFG
50	Arco #1 Maebee	sese	30-158N-103W	Williams/ND	P&A
51	Fischer #34-18	swse	18-159N-102W	Williams/ND	Madis.
52	Gerald Fischer #1	sene	31-160N-102W	Divide/ND	P&A

Notes: ** Key Well

Ratcl. = Mississippian Ratcliffe production
 Charls. = Mississippian Charles production
 M/C = Mississippian Mission Canyon production
 Madis. = Mississippian Madison production
 Interl. = Silurian Interlake production

Earth Resources Library, and the Montana Geological Survey. The core analysis done by Chevron is shown in Table 2. Core samples were taken from 11276-11453 feet (177 feet), at one-foot sample interval, beneath the "C" Anhydrite and through the Laminated and Burrowed Members. Based on core description, and measured porosities and permeabilities, the following textural differentiation can be identified:

The top of the core (Table 2) is a zone of tight and low porosity dolomite down to a core depth of about 12,283 feet. This is underlain by porous dolomites to a depth of 11,296 feet, the bottom part becoming gradational, partially dolomitized limestone. This is underlain by tight, low porosity limestones, carbonaceous and shaley in places, down to about 11,303 feet. This thin limestone zone is un laminated. From 11,304 feet to about 11,392 feet is low porosity, tight in places, very fine to fine crystalline laminated limestones. The limestones are anhydritic, shaly, vuggy, carbonaceous and dolomitic in places. From 11,393 feet to total core depth, tight, low porosity, fine crystalline limestones are dominant. The limestones are mostly un laminated. Vertical distribution of permeability shows the same variability as porosity, lithologic and textural changes. The low porosity dolomites, as well as the other low porosity rocks, have low permeabilities. Generally, porous dolomites have higher permeabilities. However, in some zones, the reverse is the case (for example, at 11,296 feet and 11,357 feet). At 11,311 feet and 11,329 feet, low porosity rocks develop relatively good permeability.

Chevron's core analysis shows that the Red River "C" zone is extremely heterogenous.

In-House Core Description

Core description format of the Chevron Melby #4-1 well considered the following elements: core depth, crystal/grain size, sedimentary structures, dolomite/limestones percent, porosity classifications, anhydrite types, shows, visual porosity, and burrows.

The core depth is from 11,272 feet to 11,452 feet. Core depths match log depths when shifted up about two feet. The following is a summarized description of rock units identified from core description:

Anhydrite (100% anhydrite): 11,272 - 11,275.5 feet (3.5 feet), bedded, "chickenwire" structures with laminated dolomite; dolomite inclusions towards the base; irregular contact at base.

Dolomite (95-100% dolomite): 11,275.5 - 11290 feet (14.5 feet); mudstone; fine to extremely fine crystals; laminated and some horizontal fractures filled with anhydrite; no visible porosity at the top; porosity develops from 11,284 feet; sucrosic and occasional microvugular porosity (10-20%); strong cuts; nine different Archie porosity classes.

Table 2. Core analysis of key well, Melby #4-1, by well operator, Chevron USA, Inc.

Well Location:	NW SW 1, T33N-58E								
Well Name:	#4-1 Melby								
Core Interval:	11276-11453'								
Formation:	Red River								
Type Analysis	Diamond Conv.								
Sample #	Depth	K/a	Porosity	Fluid/oil	Fluid/water	Description			
1	11276	<0.01	2.8	0	97.1	VF, dol, f xln, anhy.			
2	11277	<0.01	1	0	90	VF, dol, f xln.			
3	11278	<0.01	5	4	88	VF, dol, f xln.			
4	11279	<0.01	6.6	3	75.8	VF, dol, f xln.			
5	11280	<0.01	4.6	0	95.5	VF, dol, f xln.			
6	11281	<0.01	4.1	0	97.5	VF, dol, f xln.			
7	11282	<0.01	3.4	0	97	VF, dol, f xln.			
8	11283	<0.01	9.6	0	60.4	VF, dol, f xln.			
9	11284	1.9	7.9	16.4	64.4	VF, dol, f xln.			
10	11285	1.9	15.6	28.2	32	Dol, f xln.			
11	11286	22	21.3	26.8	43.2	Dol, f suc.			
12	11287	1.2	14.4	24.3	22.9	VF, dol, f suc.			
13	11288	1.1	14.3	24.4	28.7	VF, dol, f suc.			
14	11289	12	25.8	26.7	36.8	Dol, f suc.			
15	11290	1.3	14	25.7	34.2	Lm, f suc; dol.			
16	11291	0.21	9	32.2	14.5	Lm, f xln-suc, dol.			
17	11292	1.4	14.7	20.4	35.3	Lm, suc.			
18	11293	1.9	16.6	24	37.4	VF, lm, suc.			
19	11294	<0.01	2.5	0	80	VF, f xln-suc.			
20	11295	1.2	12.4	23.4	47.6	Lm, suc.			
21	11296	<0.01	17.1	24.6	44.4	VF, dol, f suc.			
22	11297	<0.01	1.2	16.7	75	VF, lm, f xln.			
23	11298	<0.01	1.3	38.5	54	VF, f xln, shly carb.			
24	11299	<0.01	1.6	12.5	81.2	VF, f xln.			
25	11300	<0.01	3.3	15.2	27.3	Lm, f xln-suc, vuggy.			

Table 2. (contd.)

26	11301	0.3	1.9	26.3	47.4	VF, lm, f xln.
27	11302	0.18	8.5	20	43.5	Lm, f xln-suc.
28	11303	0.23	2.6	7.7	30.8	Lm, f xln.
29	11304	<0.01	1.3	15.4	69.2	VF, lm, f xln.
30	11305	0.01	2.1	9.5	61.8	VF, lm, f xln, anhy.
31	11306	0.05	0.5	0	80	VF, lm, f xln.
32	11307	<0.01	0.8	0	87.5	VF, lm, f xln, anhy.
33	11308	<0.01	0.5	0	80	VF, lm, f xln.
34	11309	0.07	0.8	0	87.5	VF, lm, f xln.
35	11310	0.01	2.3	8.7	39.1	VF, lm, f xln.
36	11311	26	5.8	17.2	22.4	Lm, xln-suc, vuggy.
37	11312	0.64	4.4	11.3	45.4	VF, lm, f xln-suc, anhy.
38	11313	<0.01	4.7	4.7	35.7	VF, lm, f xln.
39	11314	<0.01	1.9	42.2	47.4	VF, lm, f xln.
40	11315	<0.01	2.8	17.8	46.4	VF, lm, f xln.
41	11316	0.21	3	16.7	56.7	VF, lm, f xln.
42	11317	<0.01	2	35	45	VF, lm, f xln.
43	11318	<0.01	1.7	0	52.9	VF, lm, f xln.
44	11319	<0.01	1.7	11.8	52.9	VF, lm, f xln, anhy.
45	11320	0.18	3.9	25.7	28.2	VF, lm, f xln, anhy.
46	11321	0.37	3.2	21.9	40.7	VF, lm, f xln.
47	11322	0.03	5	15.5	17.2	VF, lm, f xln.
48	11323	<0.01	1.1	0	81.8	VF, lm, f xln.
49	11324	0.11	2.6	38.5	34.6	VF, lm, f xln.
50	11325	0.05	2.2	45.5	27.3	VF, lm f xln, carb.
51	11326	0.09	1.7	29.4	35.3	VF, lm, f xln.
52	11327	<0.01	1.4	0	92.8	VF, lm, f xln.
53	11328	0.01	1.7	11.8	64.7	VF, lm, f xln.
54	11329	8.3	4	25	47.5	VF, lm, f xln.
55	11330	<0.01	3.4	20.5	38.2	VF, lm, f xln-cse xln.
56	11331	<0.01	2.2	31.8	40.8	VF, lm, f xln-cse xln.
57	11332	0.31	3.5	20	48.5	VF, lm, f xln.

Table 2. (contd.)

58	11333	0.14	7.2	12.5	29.2	VF, lm, f xln.
59	11334	0.16	5.6	23.2	26.8	VF, lm, f xln.
60	11335	0.01	4.8	10.4	62.5	VF, lm, f xln, dol.
61	11336	0.01	4.9	14.3	51	Lm f xln.
62	11337	1.4	10	15	56	Lm, f xln-suc.
63	11338	0.13	4.9	10.2	42.8	VF, lm, xln-suc.
64	11339	0.6	4	12.5	32.5	Lm, f xln.
65	11340	0.11	4.3	10.4	35.4	Lm, f xln.
66	11341	0.86	6.3	14.3	36.5	VF, lm, f xln, dol.
67	11342	1.2	8.1	18.5	32.1	VF, lm, f xln, dol.
68	11343	1.8	3.4	14.7	44.1	VF lm, f xln.
69	11344	0.13	2.1	9.5	61.7	Lm, f xln.
70	11345	0.83	2.8	7.1	46.3	Lm, f xln.
71	11346	0.31	2.8	17.2	44.8	Lm, f xln.
72	11347	0.12	4.2	16.6	40.4	Lm, f xln.
73	11348	0.45	2.4	8.3	54.2	Lm, f xln.
74	11349	3.4	2.4	8.3	54.2	Lm, f xln.
75	11350	1.4	2.5	52	24	lm, f xln, shly.
76	11351	<0.01	2.5	32	36	VF lm, f xln.
77	11352	0.77	4.7	10.6	23.4	VF lm, f xln.
78	11353	0.59	3	16.6	43.2	VF lm, f xln.
79	11354	<0.01	2.1	38	42.8	VF, lm, f xln, shly.
80	11355	0.24	4.2	23.8	31	Lm, f xln.
81	11356	0.33	2.1	38	33.3	VF, f xln.
82	11357	<0.01	8.6	90.6	7	Lm, f xln, anhy, v/shly.
83	11358	<0.01	1.4	14.3	64.4	Lm, f xln.
84	11359	0.34	4.5	29.9	33.3	Lm, f xln-suc.
85	11360	<0.01	0.9	0	78	VF, lm, f xln-suc.
86	11361	<0.01	1.4	14.3	64.3	VF, lm, f xln.
87	11362	0.14	2	10	65	VF, lm, f xln.
88	11363	0.01	3.2	15.6	46.8	VF, lm, f xln.
89	11364	0.34	3.6	5.5	41.6	VF, lm, f xln.

Table 2. (contd.)

90	11365	<0.01	1.7	11.8	76.5	VF, lm, f xln.
91	11366	<0.01	1.2	0	75	VF, lm, f xln.
92	11367	<0.01	1	0	90	VF, lm, f xln.
93	11368	0.1	1.4	14.3	28.6	VF, lm, f xln.
94	11369	0.54	1.9	26.3	79	VF, lm, f xln.
95	11370	0.08	2	10	65	Lm, f xln.
96	11371	0.42	1.8	27.8	50	VF, lm, f xln.
97	11372	<0.01	1.2	16.6	75	VF, lm, f xln.
98	11373	0.12	3.3	15.1	39.4	VF, lm, f xln.
99	11374	0.03	3	16.6	50	VF, lm, f xln.
100	11375	0.26	1	0	90	VF, lm, f xln.
101	11376	<0.01	4	12.5	33.3	VF, lm, f xln.
102	11377	0.05	7.9	86.1	7.6	Lm, f xln, v/shly.
103	11378	0.4	4.9	16.3	26.6	Lm, f xln.
104	11379	1.9	5.5	18.2	31	VF, lm, f xln.
105	11380	0.15	1.7	29.4	53	VF, lm, f xln.
106	11381	0.03	4	75	16	VF, lm, f xln, shly.
107	11382	<0.01	0.8	0	87.5	Lm, f xln.
108	11383	0.02	1	0	90	VF, lm, f xln.
109	11384	0.24	1.6	0	81.2	VF, lm, f xln.
110	11385	0.12	5.6	14.3	35.7	VF, lm, f xln-suc.
111	11386	0.3	6.5	15.4	32.3	VF, lm, f xln-suc.
112	11387	<0.01	2.3	0	73.8	VF, lm, f xln.
113	11388	<0.01	1.1	0	81.8	VF, lm, f xln.
114	11389	<0.01	1	0	90	VF, lm, f xln.
115	11390	<0.01	1	0	90	VF, lm, f xln.
116	11391	<0.01	1.4	0	78.5	VF, lm, f xln.
117	11392	<0.01	0.8	0	87.6	VF, lm, f xln.
118	11393	<0.01	1	0	90	Lm, f xln.
119	11394	<0.01	1	0	90	Lm, f xln.
120	11395	<0.01	1	0	90	Lm, f xln.
121	11396	<0.01	1	0	90	Lm, f xln.

Table 2. (contd.)

122	11397	<0.01	1.2	0	75	VF, lm, f xln.
123	11398	<0.01	1.3	0	84.6	Lm, f xln.
124	11399	<0.01	1.4	0	78.6	VF, lm, f xln.
125	11400	<0.01	1	0	90	Lm, f xln.
126	11401	<0.01	1	0	90	Lm, f xln.
127	11402	<0.01	1.5	0	86.6	Lm, f xln.
128	11403	<0.01	1.2	0	91.6	Lm, f xln.
129	11404	<0.01	1.4	0	64.2	Lm, f xln.
130	11405	0.42	1.8	0	72.2	Lm, f xln.
131	11406	<0.01	0.9	0	77.7	Lm, f xln.
132	11407	<0.01	1.1	0	82	Lm, f xln.
133	11408	<0.01	1	0	90	Lm, f xln.
134	11409	0.54	1.9	0	79	Lm, f xln.
135	11410	<0.01	1.2	0	91.5	Lm, f xln.
136	11411	<0.01	1.1	0	82	Lm, f xln.
137	11412	<0.01	1	0	90	Lm, f xln.
138	11413	<0.01	1.3	0	69.3	Lm, f xln.
139	11414	0.14	1	0	90	Lm, f xln.
140	11415	0.01	1.2	0	75	Lm, f xln.
141	11416	0.01	1	0	90	Lm, f xln.
142	11417	<0.01	1	0	90	VF, lm, f xln.
143	11418	<0.01	1.1	0	82	Lm, f xln.
144	11419	<0.01	1.3	0	69.2	Lm, f xln.
145	11420	<0.01	1.6	0	81.2	Lm, f xln.
146	11421	<0.01	1.2	0	91.5	Lm, f xln.
147	11422	<0.01	1.1	0	82	Lm, f xln.
148	11423	<0.01	1.2	0	75	VF, lm, f xln.
149	11424	<0.01	1.4	0	93	Lm, f xln.
150	11425	<0.01	1.8	0	72.2	VF, lm, f xln.
151	11426	<0.01	1	0	90	Lm, f xln.
152	11427	<0.01	1.1	0	82	Lm, f xln.
153	11428	<0.01	1.4	0	93	VF, lm, f xln.

Table 2. (contd)

154	11429	0.22	1.4	0	93	VF, lm, f xdn.
155	11430	<0.01	1.5	0	86.6	Lm, f xdn.
156	11431	<0.01	1.9	0	68.5	VF, lm, f xdn.
157	11432	<0.01	2	0	75	Lm, f xdn.
158	11433	<0.01	1.2	0	91.8	Lm, f xdn.
159	11434	<0.01	1.4	0	93	Lm, f xdn.
160	11435	<0.01	1.4	0	93	Lm, f xdn.
161	11436	<0.01	1.4	0	93	Lm, f xdn.
162	11437	<0.01	1.2	0	91.8	Lm, f xdn.
163	11438	<0.01	1	0	90	Lm, f xdn.
164	11439	<0.01	8.8	8	49	Lm, f xdn-suc, dol, anhy.
165	11440	<0.01	1.4	1.4	57.2	Lm, f xdn.
166	11441	<0.01	1	0	90	Lm, f xdn.
167	11442	<0.01	1	0	90	Lm, f xdn, foss.
168	11443	<0.01	1	0	90	Lm, f xdn.
169	11444	<0.01	1	0	90	Lm, f xdn.
170	11445	<0.01	1.4	0	92.8	Lm, f xdn.
171	11446	<0.01	1	0	90	Lm, f xdn.
172	11447	<0.01	1.4	0	64.2	Lm, f xdn.
173	11448	<0.01	1.1	0	81.8	VF, lm, f xdn.
174	11449	<0.01	1	0	90	VF, lm, f xdn.
175	11450	<0.01	1	0	90	Lm, f xdn.
176	11451	<0.01	1	0	90	Lm, f xdn.
177	11452	<0.01	1.3	0	84.7	Lm, f xdn.

Dolomitic limestone (60-80% dolomite or 20-40% limestone): 11,290 - 11,293.5 feet (3.5 feet); mudstone; very fine to microcrystalline, greater dolomite at the top becoming increasingly calcitic toward the base; occasional abundant laminated carbonaceous material; traces of chondrites and intraclasts; dull to greenish-yellow fluorescence; three different Archie porosity classes; visual porosity 11-13%.

Limestone (15-30% dolomite or 70-85% limestone): 11,294 - 11,304.5 feet (10.5 feet); mudstone grading to packstone and grainstone at the base; limestone becoming dolomitic; nodular anhydrite and anhydrite fill; occasional kerogen-rich beds; abundant burrowing; fossil materials; 12 different Archie porosity classifications, development of vugs at the base; visual porosity 0% at the top to low (2-6%) at the bottom; extremely fine to microcrystalline.

Limestone (90-95% limestone or 5-10% dolomite): 11,304.5 - 11,322.5 feet (18 feet); mostly wackestone; zero to low visual porosity (0-4%); extremely fine to microcrystalline; good porosity in places (6-12%) corresponding to very coarse to microcrystalline; discontinuous laminations; bioclastic materials; fossil materials often replaced with anhydrite; vuggy or moldic porosity in channels; burrows often microsucrosic; occasional kerogen-rich burrows; seven different Archie porosity classes.

Limestone (65-85% limestone or 15-35% dolomite): 11,322.5 - 11,358 feet (18 feet). Mudstone and wackestone, very fine to extremely fine crystals; chondrites burrows, often dolomitized; kerogen materials; fracture porosity; occasional anhydrite nodules; yellow-green fluorescence; irregular laminations; 12 different Archie porosity classes; visual porosity 0-10%.

Interbedded dolomite/limestone (50-70% dolomite or 30-50% limestone): 11,358 - 11,453 feet (95 feet); wackestone; very fine to extremely fine crystals; dolomite interbedded with limestone; kerogenite filling burrows; higher bioclastic content than previous sections; shows in dolomites; anhydrite decreasing to trace amounts; occasional pellet zones; visual porosity mostly 0-3%. Zero percent visual porosity and single Archie porosity class from 11,387 feet to core TD.

Red River "C" Zone Structure

A structural map of top of the "C" zone is shown in Figure 4. The contour interval is 25 feet in the Montana area. It is 100 feet in the North Dakota side because of sparse well control. The map shows a general northwest-southeast structural trend. Existing fields are located on structural closures. Producing wells are located on both crests and flanks of structures.

Figure 4. Structural map - Top of Red River "C" zone Anhydrite. C.I. = 25 ft. and 100 ft. Bold circles are locations of wells used in the study. Two lines of stratigraphic cross-sections, N-S and E-W, are also shown.

CHAPTER 3 - ROCK PROPERTIES, PETROPHYSICAL ANALYSIS AND INTERPRETATION

Laboratory Measurements

Vertical plug samples were cut from the slab samples beginning at 11,272 feet and ending at 11,452 feet. The goal was to take samples at approximately one foot spacing from 11,272 feet to 11,372 feet, and two feet spacing from 11,372 to 11,452 feet. Most of the plugs were one-inch in diameter. In a few cases, one inch plugs could not be cut because the slab was too thin, and, in those instances, 3/4-inch plugs were taken. Plugs were cut with fresh water and their ends were ground flat and parallel. A total of 141 plugs were cut from the core.

A few discrepancies were found in the core numbering. Samples in the sequence 11,297 feet and 11,298 feet were apparently mislabeled 11,397 and 11,398 feet. Two other samples labeled 11,397 feet and 11,398 feet were found in the correct sequence and so we conclude that the pair in the upper sequence were mislabeled. Also, according to the depths marked on the core boxes there was a break in the core from 11,334 feet to 11,343 feet. However, there was no missing section in the core itself.

The lengths and weights of the samples were measured after the samples were aired at 104°F (40° Celcius) for 24 hours. Then, the samples were evacuated and saturated with 100,000 ppm sodium chloride brine. The saturated samples were weighed in air and then again while suspended in the pore saturant. Density of pore saturant was 1.09 gm/cc.

Compressional and shear wave acoustic velocity measurements were run on each brine-saturated sample in a sequence of five effective stress conditions. With the fluid pressure kept constant at 200 psi, effective stresses used ranged from 500 to 6,500 psi, the maximum corresponding, approximately, to 0.57 times the sample depth in feet. The stresses used were isotropic (hydrostatic). Laboratory core measurements are shown in Appendix A.

Crossplots of Core Data

The Red River "C" zone exhibits a complex reservoir system. The system shows, as indicated in the core descriptions, rapid vertical variations of rock-types, pore systems, and permeability. These characteristics are exemplified in the following crossplots:

a. Core porosity versus core permeability (Data from Table 2)

Conventional core measurements of porosity and permeability provided the opportunity to examine the relationships between these two properties in the Chevron Melby #4-1 key well. A semi-log crossplot between core porosity and core permeability can aid in the segregation of rock-types by pore-types, and hence

specific reservoir rock-types. In the key well, the porosity from the Red River "C" zone reveals abundant scatter around a best fit linear regression line (Figure 5). Such scatter is usually a manifestation of a wide variation in the number of reservoir pore types, although induced fracturing ("microcracks") and non-touching vugs can also contribute to the scatter in the data (Lucia, 1983; Lucia and Conti, 1987). Identification of abundant separate vug porosity in some intervals during visual core inspection supports the idea that some of the scatter in the data is attributable to this pore type.

The overall poor relationship between core porosity and permeability, together with the significant scatter in the data, can be interpreted as information from an extremely heterogeneous reservoir. This heterogeneous reservoir pore system was also revealed in the visual core description, and has been discussed in greater detail by previous workers (Longman, Fertal, and Glennie, 1983; Kohm and Loudon, 1988; Friedman, Ruzyla, and Reckmann, 1981).

However, in these earlier studies, higher permeability rock was encountered in the Red River "C" zone than was observed in the Melby #4-1. The higher permeability encountered outside of the Melby #4-1 well in the earlier studies, probably, indicates that additional major rock-type changes are present in the study area that do not occur in the Melby #4-1 key well.

b. Core porosity versus bulk density

Crossplot of core porosity versus bulk density also shows a wide scatter of points around a best fit linear regression line (Figure 6). The core porosity comes from Table 2, and bulk density comes from the density log correlated with core measurements in the key well. The abundant scatter indicates wide variability of matrix (grain) densities, and therefore, rock-types. If hydrocarbons, especially gas, were present, the scatter would be much wider. Data points representing gas zones would be displaced in the direction of decreasing bulk density. The bulk density - porosity relationship is one of the criteria used in this project to discriminate and identify rock-types.

The wide variation in matrix densities is corroborated by a log of matrix densities obtained from laboratory core measurements in the Melby #4-1 well (Appendix A). The log is shown in Figure 7.

Based on matrix densities alone, we have introduced the following genetic grouping and coding of rock-types:

<u>Matrix Density (gm/cc)</u>	<u>Rock-type Code</u>	<u>Genetic Description</u>
<2.70	1	Limestone with sand or shale influence. Also sandstone or shale shale or kerogenite.

<u>Matrix Density (gm/cc)</u>	<u>Rock-type Code</u>	<u>Genetic Description</u>
2.70-2.75	2	Pure limestone, and limestone with slight dolomite influence.
2.75-<2.80	3	Limestone with major dolomite influence influence, (dolomitic limestone).
2.80-<2.85	4	Pure dolomite with minor anhydrite influence.
2.85-<2.90	5	Anhydritic dolomite.
2.90->2.90	6	Mainly Anhydrite.

These same rock-type codes have been adopted in the rock-typing section of this report (Chapter 4). Table 3, shows a complete depth distribution of measured core matrix densities and porosities in the Melby #4-1 key well. With increasing depth, anhydrite (Code 6) is underlain by anhydritic dolomite (code 5) and dolomite (code 4) which, in turn, are underlain by combinations of partially dolomitized limestone (code 3) and limestone (code 2). The highest development of porosity is in rock-types with code 4 and code 5. The Melby #4-1 also produces from these rock-types. The rock-type with code 6 correlates with the "C" Anhydrite zone; rock-types with code 5 and code 4 generally correlate with the "C" Laminated zone, while rock-types with codes 3 and 2 correlate with the "C" Burrowed zone.

A closer look at the distribution of rock-type codes in Table 3 shows that a thin layer of the rock-type with code 3 (partially dolomitized limestone) actually underlies the rock-type with code 6 (anhydrite). This occurrence is not uncommon in many of the wells studied. Also note that the rock-type with code 6 that directly overlies the rock-type with code 3 has a porosity of 2%. Again, results from rock-typing (next chapter) show that low porosity rock-types with code 6 are not uncommon. Instead of pure anhydrite, we interpret such rock-types to be cryptocrystalline anhydritic dolomite.

In places (11,289 feet to 11,304 feet, and 11,339 feet to 11,343 feet), the rock-type with code 4 (dolomite) interfingers with rocks of codes 3 (dolomitic limestone) and 2 (limestone). The anomalous grain density of 2.61 gm/cc may belong to argillaceous debris or kerogenite, or some unknown lithology. Results from rock-typing in the rest of the wells studied corroborate these observations.

Contrary to previous studies' conclusions, the Red River "C" zone is not an orderly layering, with increasing depth, of three lithologic types -- anhydrites, dolomites and limestones.

It is rather a heterogenous arrangement of non-porous anhydrites underlain by porous and non-porous dolomites, anhydritic dolomites, dolomitized limestones and limestones with occasional occurrences of kerogenite, mud or argillaceous debris. This lithologic heterogeneity also implies heterogenous depositional environments and diagenetic history.

Chevron Melby 4-1
 NW SW Section 1, T33N-R58E
 Brush Lake Field, Montana

000000 Red River 'C' Data
 Conventional Analysis
 Unsorted Data

Figure 5. Semi-log crossplot core permeability versus core porosity in the key well, Chevron Melby #4-1.

Chevron Melby 4-1
 NW SW Section 1, T33N-R58E
 Brush Lake Field, Montana

ooooo Red River 'C' Data
 Conventional Analysis
 All Data (11,276 to 11,452 ft)

Figure 6. Crossplot bulk density versus core porosity in the key well, Chevron Melby #4-1.

Figure 7. Log of matrix densities in the key well, Chevron Melby #4-1.

Table 3. Depth distribution of rock-types, matrix densities, and porosities.

**Chevron Melby 4-1 NWSW 1-33N-58E
Sheridan County, Montana**

Laboratory Measurements of Rock Properties

<u>Depth</u>	<u>Core Porosity (%)</u>	<u>Matrix Density(gm/cc)</u>	<u>Rock-type Code</u>
11272	0.1	2.94	6
11273	0.1	2.95	6
11274.5	0.1	2.94	6
11275.5	0.5	2.91	6
11276.5	2.0	2.98	6
11277.5	2.2	2.77	3
11278.5	3.8	2.83	4
11279.5	6.3	2.85	5
11280	5.6	2.85	5
11281	6.1	2.85	5
11282	6.2	2.85	5
11283	5.6	2.85	5
11284	6.1	2.82	4
11285	10.5	2.83	4
11286	7.0	2.79	3
11287	13.1	2.81	4
11288	12.2	2.82	4
11289	19.1	2.79	3
11290	13.3	2.79	3
11291	7.5	2.80	4
11292	8.2	2.77	3
11293	16.0	2.82	4
11294	12.6	2.80	4
11295	8.5	2.77	3
11296	1.1	2.78	3
11297	10.1	2.77	3
11298	2.7	2.80	4
11299	0.8	2.75	2
11300	1.2	2.78	3
11301	3.5	2.72	2
11302	10.5	2.77	3
11303	6.0	2.81	4
11304	2.3	2.74	2
11305	1.6	2.72	2
11306	1.1	2.72	2
11307	1.1	2.71	2
11308	1.4	2.71	2
11309	1.6	2.73	2
11310	1.6	2.72	2
11311	2.8	2.71	2
11312	2.8	2.73	2
11313	4.8	2.78	3
11314	2.8	2.73	2
11315	0.9	2.72	2
11316	3.6	2.75	2
11317	3.0	2.78	3

Table 3. (contd.)

<u>Depth</u>	<u>Core Porosity (%)</u>	<u>Matrix Density(gm/cc)</u>	<u>Rock-type Code</u>
11318	2.6	2.72	2
11319	2.4	2.72	2
11320	3.6	2.71	2
11321	2.4	2.72	2
11322	2.2	2.72	2
11323	2.0	2.74	2
11324	2.3	2.72	2
11325	2.6	2.71	2
11326	1.5	2.71	2
11327	5.2	2.71	2
11328	3.2	2.72	2
11329	5.6	2.72	2
11330	1.6	2.74	2
11331	1.8	2.70	2
11332	5.5	2.75	2
11333	1.6	2.73	2
11334	6.6	2.77	3
11335	5.6	2.78	3
11336	3.6	2.77	3
11337	14.2	2.78	3
11338	6.0	2.78	3
11339	2.3	2.73	2
11340	5.7	2.80	4
11341	6.1	2.78	3
11342	8.5	2.80	4
11343	3.4	2.77	3
11344	2.2	2.78	3
11345	2.9	2.78	3
11346	5.0	2.78	3
11347	3.1	2.76	3
11348	4.0	2.78	3
11349	2.9	2.77	3
11350	1.4	2.61	1
11351	1.1	2.61	1
11352	2.2	2.74	2
11353	3.8	2.75	2
11354	2.2	2.76	3
11355	1.2	2.73	2
11356	4.1	2.76	3
11357	1.5	2.74	2
11358	0.9	2.74	2
11359	4.9	2.75	2
11360	3.7	2.76	3
11361	0.9	2.75	2
11362	1.9	2.74	2
11363	3.3	2.75	2
11364	3.6	2.79	3
11365	3.2	2.76	3
11366	1.6	2.79	3
11367	1.9	2.76	3
11368	3.0	2.78	3

Table 3. (contd.)

<u>Depth</u>	<u>Core Porosity (%)</u>	<u>Matrix Density(gm/cc)</u>	<u>Rock-type Code</u>
11369	2.2	2.73	2
11370	2.8	2.78	3
11371	1.8	2.79	3
11372	1.2	2.72	2
11374	4.2	2.80	4
11376	1.9	2.73	2
11378	1.9	2.76	3
11380	4.4	2.81	4
11382	1.1	2.77	3
11384	1.8	2.76	3
11386	5.1	2.81	4
11388	1.4	2.73	2
11390	1.0	2.73	2
11392	1.1	2.73	2
11394	1.3	2.74	2
11396	1.0	2.75	2
11398	1.3	2.74	2
11400	1.4	2.76	3
11402	1.8	2.75	2
11404	1.2	2.75	2
11406	2.3	2.76	3
11408	1.2	2.74	2
11410	2.3	2.77	3
11412	1.7	2.76	3
11414	1.8	2.74	2
11416	1.7	2.78	3
11418	1.4	2.74	2
11420	1.5	2.74	2
11422	1.9	2.75	2
11424	1.8	2.76	3
11426	2.0	2.76	3
11428	2.5	2.76	3
11430	1.9	2.74	2
11432	1.3	2.72	2
11434	1.4	2.72	2
11436	1.9	2.76	3
11438	1.7	2.74	2
11440	1.5	2.72	2
11442	1.3	2.72	2
11444	1.6	2.74	2
11446	1.5	2.74	2
11448	1.6	2.73	2
11450	1.5	2.71	2
11452	1.2	2.71	2

CHAPTER 4 - ROCK-TYPING

Three rock-typing criteria that make use of routine borehole measurements were used to discriminate rock-types. A fourth and new criterion was added, primarily to characterize carbonates (as opposed to clastics), and, secondly, because of its potential impact in the characterization of all types of reservoirs (including gas and low permeability reservoirs) from both borehole and reflection seismic data.

These criteria are:

1. Lithology: Prior knowledge of lithology is important because it causes one to look for those rock-types known from experience to be associated with the lithology. For example, since the Red River "C" zone is a carbonate sequence, we know from experience that possible rock-types would include limestone, dolomitic limestone, dolomite, anhydritic dolomite and anhydrite. Carbonate sequences also have the tendency for cyclic sedimentation. Therefore, in studying the Red River "C" zone, we anticipated full or partial cycles of the above-named rock-types.
2. Relationship between porosity and porosity log response (acoustic and density).
3. Relationship between water saturation and porosity;
4. Relationship between the V_p/V_s ratio and V_p .

Background: Concept of "Rock Property Interrelations"

Individual rock properties by themselves are not sufficient to make meaningful interpretations of the subsurface. This is because the rock properties themselves are affected by other rock properties and sedimentological conditions of the rock. Also, several rocks can share the same property. For example, velocity is affected by the individual lithology or rock-type, porosity, textural characteristics, internal rock architecture, and depth of burial or effective stress. Porosity, on the other hand, cannot be measured directly in the subsurface but relies on indirect measurement of other properties.

Fortunately, rock properties themselves are interrelated, and scientists have been able to establish empirical and response relations for most measurable rock properties. It is therefore possible to form equations or interrelations between rock properties (Pickett and Ikwaakor, 1979; Ikwaakor, 1980). Sometimes, rock property interrelations involve more than two rock property measurements. For example, the Archie equation used to estimate water saturation involves four rock property measurements (Archie, 1942). These interrelations have proven more useful for interpreting geology than the use of single rock property measurements.

Interrelations are formed through a simple algebraic process we have named Simultaneous Intergration Process (SIP) (Pickett and Ikwuakor, 1979). An important application of the concept is "rock-typing." The concept is also the basis for the techniques we have applied (in Chapter 5) to estimate water saturation from well logs.

Formulation of Rock Property Interrelations

The following are known response relations for bulk density (P_b) and acoustic logs (Δt):

$$P_b = P_m - (P_m - P_f) \phi \dots\dots\dots(1)$$

and

$$1/V = \Delta t = \Delta t_m + B\phi \dots\dots\dots(2)$$

P_m is matrix density, P_f is fluid density and ϕ is porosity. P_m and P_f are expressed in gm/cc. Δt is transit-time on the acoustic log in $\mu\text{sec}/\text{ft}$; Δt_m is transit-time of the matrix material; B is a constant dependent upon lithology or rock-type, effective stress and grain contact area. B is usually expressed in $\mu\text{sec}/\text{ft}/\phi$, where ϕ may be expressed as a fraction or as a percent.

Equation 2 is known to be valid for both shear wave velocity (V_s) and compressional wave velocity (V_p) (Ikwuakor, 1988; Pickett, 1963). Therefore Eq.2 can be rewritten as follows for compressional wave velocity and shear wave velocity, respectively:

$$1/V_p = \Delta t_p = \Delta t_{mp} + B_p \phi \dots\dots\dots(3)$$

and

$$1/V_s = \Delta t_s = \Delta t_{ms} + B_s \phi \dots\dots\dots(4)$$

Subscripts "p" and "s" refer to compressional wave and shear wave, respectively.

Involvement of a common variable, such as porosity (ϕ) in Eqs.1, 2, 3 and 4 is used to an advantage. It shows that P_b , Δt_p and Δt_s are interrelated. Elimination of the common variable, ϕ , between Eqs. 1 and 3 leads to:

$$\Delta t_p = \Delta t_{mp} + (B_p P_m)/(P_m - P_f) - [B_p/(P_m - P_f)][P_b] \dots\dots(5)$$

Ikwuakor (1988) derived from Eqs. 3 and 4 the following equation relating the V_p/V_s ratio and V_p :

$$\Delta t_s/\Delta t_p = V_p/V_s = B_s/B_p + [\Delta t_{ms} - (B_s/B_p) \Delta t_{mp}][V_p] \dots(6)$$

Equation 6 shows that for a given rock-type and effective stress, the V_p/V_s ratio is linearly related with V_p .

Equations 1, 2, 3, 4, 5, and 6 are all linear equations (of the form, $y = mx + c$), for a given rock type. Each has well-defined slope and intercept terms. They constitute the source of rock-typing parameters, such as, matrix density, P_m , in Eq. 1, and coefficients, Δt_{mp} , Δt_{ms} , B_p , and B_s in Eqs. 3 and 4. It should be noted that these rock-typing parameters occur singly as slope and intercept terms in Eqs. 1, 3 and 4, and in combination as slope and intercept terms in Eqs. 5 and 6. Even when they occur in such combinations, the slopes and intercepts of the equations are also rock-typing parameters (Ikwuakor, 1980, 1988). Generally, in a given geological section, a set of these rock-typing parameters will quantitatively characterize any rock-types present. Equations 1, 2, 3, 4, 5, and 6 are the basis for the rock-typing done in this study.

The Rock-Typing Process

Several activities constituted the rock-typing process in this study.

1. Well log quality control

The broad objective of quality control is to ensure that analytical results are of adequate accuracy. Segregation and identification of rock-types is sensitive to small changes in measured rock properties. In the study, it was important not only to achieve quantitative accuracy but also to standardize borehole measurements in all the wells studied.

Measurement problems were observed in the Neutron porosity and acoustic (sonic) logs. Prior knowledge of the petrophysical characteristics of anhydrites, and information obtained from the laboratory measurements on cores in the Melby #4-1 key well provided symptoms of error in the neutron porosity and sonic logs. For example, characteristic porosity and Δt values of anhydrite are 0% and 50 usec/ft., respectively.

In the "C" Anhydrite, neutron porosities ranged between 0% and 2.6%. Deviations from 0% are therefore symptomatic of error. In all wells where deviations occur, neutron porosities were corrected by adding the deviations to the log values.

Sonic log (Δt) readings in the "C" Anhydrite ranged between 50 and 54 usec/ft. Δt readings were corrected by subtracting the difference between the reading in the "C" Anhydrite and 50 usec/ft.

Although there were no obvious indications of error in the density log, density porosities were considered erroneous because they were derived by using a matrix density of 2.71 gm/cc, when, as was noted earlier, the "C" zone has wide variation of matrix densities. Despite this inherent error, density porosities by themselves were not corrected because it would have required assigning accurate matrix densities to each zone. Rather uncorrected density porosities were used in conjunction with

corrected neutron porosities to determine porosities ("crossplot porosities") used to identify rock-types and determine water saturations.

2. Zonation

Zonation is the division of the log section of interest into units (zones) whose rock properties are relatively uniform compared to those of other zones. An example of continuous zonation is shown in Figure 8. The density/neutron porosity logs were initially zoned and numbered. The numbered zones were then correlated on the sonic and resistivity logs.

In order to capture the wide variability of rock-types, the density log was selected as the type log for zonation. This choice also created a problem because the variability and detail shown in the bulk density log were not usually repeated in the neutron porosity, sonic, and resistivity logs. In such situations, when any particular zone could not be correlated easily, we resorted to "depth-matching." In several instances, even when the zones could be correlated, they did not always correlate depth to depth.

3. Determination of "crossplot porosities:" Porosities used in crossplots

Attempts were made to calibrate log porosities using core porosities, Sidewall Neutron Porosity (SNP), and density porosities from the Melby #4-1 key well. Linear-linear crossplots were made between core porosities and SNP, and also between core porosities and the average of SNP and density porosities. The crossplots exhibited linear relationships, but the scatter of data points was too wide to allow formulation of a meaningful, deterministic linear equation that could be used for porosity calibration.

Considering the importance of porosities in the rock-typing process, the above porosity calibration approach was abandoned for the following reasons:

- a. Uncertainty arising from the wide scatter of data points. Only porosities that fall on the best-fitting line would be accurately calibrated; the rest would still suffer varying degrees of error.
- b. Neutron porosities themselves were erroneous in several wells (as discussed earlier).
- c. Density porosities also are inherently erroneous, except those few zones where the matrix density is 2.71 gm/cc (assumed matrix density by logging company). As indicated earlier, matrix densities in the "C" zone vary widely.
- d. Considering the regional scope of this study, it would be risky to assume that a calibration equation

COMPENSATED NEUTRON LITHO-DENSITY LOG

SUN SUNDSTED #1
NENW SEC 6-33N-57E
KB 2272'

FIGURE 8
EXAMPLE OF CONTINUOUS ZONATION

formulated in the Melby #4-1 key well locality would still be valid in other wells several miles away.

Faced with the above problems, we came up with an alternative and systematic process to obtain porosities that were used in rock-typing, and quantitative formation evaluation. The process involved, first, correcting neutron porosities in each well, as described earlier. "Crossplot porosities" were then determined as the calculated average between the corrected neutron porosity and density porosity. Crossplot porosity was regarded as zero if the calculated average was zero or less than zero.

4. Log/Core Correlations

Laboratory measurements of acoustic velocities, bulk densities, and porosities qualitatively match their respective logs in the Melby #4-1 key well. Figures 9, 10 and 11 are the logs of measured reciprocal acoustic velocities, bulk densities, and core porosities. The well log/core depth differential is between one and two feet.

5. Digitization

The digitizing software could not be used to digitize point by point. Moreover, the digitized values lacked the precision we needed for rock-typing. Digitized porosities, for example, were between 0.2% and 0.5% higher than the actual log porosities. Faced with this problem, we decided to read the values by eye.

6. Characterization of the Red River "C" zone.

Lithology was recognized as one of the four rock-typing criteria used in this study. Prior knowledge of lithology helps to predict rock-types that may be present.

Although the main objective in the study was to determine rock-types present in the "C" zone carbonates, experience has also shown that carbonate sequences have unique and quantifiable petrophysical characteristics that are different from those of, say, sandstones. It was necessary, in order to quantify carbonate characteristics, to make laboratory measurements of compressional wave velocities (V_p), shear wave velocities (V_s), porosities and bulk densities. Interrelations involving these physical properties were formulated.

In characterizing carbonates, limestones, dolomites, anhydrites, and the gradations of these have been lumped together. In order to effect carbonate characterization, the following linear-linear crossplots were made, using laboratory measurements on cores from the Melby #4-1 key well:

1. Δt_p versus ϕ (ref. Eq. 3)
2. Δt_s versus ϕ (ref. Eq. 4)

Chevron Melby #4-1
Core interval transit-time

Chevron Melby #4-1
Borehole compensated sonic log

Figure 9. Comparison of core measurements of acoustic interval transit-time and BHC Sonic log for the Chevron Melby #4-1 key well.

Chevron Melby #4-1
Core bulk density

Chevron Melby #4-1
Bulk Density log

Figure 10. Comparison of core bulk density and density log for the Chevron Melby #4-1 key well.

Chevron Melby #4-1

Figure 11. Comparison of core porosity and Sidewall Neutron Porosity (SNP) log for the Chevron Melby #4-1 key well.

3. Δt_p versus P_b (ref. Eq. 5)

4. V_p/V_s ratio versus V_p (ref. Eq. 6)

Each crossplot was made for four different effective stresses at which measurements of V_p and V_s were made (500, 1500, 3500, and 6500 psi). Crossplots were made for the entire Red River "C" zone, the combined "C" laminated and "C" burrowed members, and the "C" burrowed member only.

Each crossplot was fitted with a best-fitting straight line by the method of linear regression analysis. The slopes and intercepts of the straight lines were determined and used to characterize the carbonates. The slopes and intercepts are made of single or combinations of rock-typing parameters, such as, P_m , P_f , Δt_{mp} , Δt_{ms} , B_s , and B_p .

The degree of scatter of data points shown in each crossplot reflects the sensitivity of the crossplot to rock-type changes. The wider the scatter, the greater the sensitivity. Additional research needs to be done to identify rock-types segregated in those crossplots involving shear wave velocities.

Results from the crossplots are shown in Table 4. Table 5 is also presented in order to compare the results from this study with values of slopes and intercepts predicted from a previous study (Ikwaakor, 1988). All the above crossplots are shown in Appendix B. Although the results in Tables 4, and 5 for carbonates are not in quantitative agreement, they are similar and both are significantly different from the values for sandstone.

7. Identification of rock-types

"Rock-typing" applies graphical methods to discriminate rock-types according to their pore-size distribution and, sometimes, pore saturant. Each graph or crossplot used is based on response relations or interrelationships between pairs of rock property measurements. The interrelationships contain elements of depositional environment (e.g., textural characteristics), rock competence, cementation, grain contact areas, fractures, secondary porosity, vugs, and pore fluids. Accurate interpretation of these elements requires the use of multiple rock-typing criteria and multiple crossplots.

The following crossplots were made, using data from well logs:

a. Bulk density versus "crossplot porosity."

This crossplot is based on the linear relationship between bulk density (P_b) and porosity (ϕ) (see Eq.1)

b. Acoustic interval transit time versus "crossplot porosity."

Table 4. Slopes and intercepts for the Red River "C" zone carbonates, derived from linear regression analysis fit of Equations 3, 4, and 6 in this study.

1. <u>Unsorted</u>						
Effective Stress (psi)	Eq.3 Slope Bp	Eq.3 Int. Δ tmp	Eq.4 Slope Bs	Eq.4 Int. Δ tms	Eq.6 Slope Δ tms-(Bs/Bp) Δ tmp	Eq.6 Int. Bs/Bp
500	113.0	49.9	184.0	105.6	2.1×10^{-6}	2.0
1500	98.8	49.3	143.0	100.7	11.5×10^{-6}	1.8
3500	81.4	48.7	103.0	97.3	19.1×10^{-6}	1.6
6500	68.5	48.1	83.2	94.3	19.9×10^{-6}	1.5
2. <u>Laminated and burrowed intervals</u>						
500	114.0	49.8	195.0	104.7	-1.4×10^{-6}	2.1
1500	100.0	49.2	152.0	100.0	9.9×10^{-6}	1.8
3500	82.4	48.6	113.0	96.5	15.5×10^{-6}	1.6
6500	69.9	48.0	92.9	93.5	17.0×10^{-6}	1.6

Notes: Units of Δ tmp and Δ tms are usec/ft. Units of Bp and Bs are usec./ft./fractional porosity.

Table 5. Slopes and intercepts for sandstone and limestone, from previous study, derived from linear regression analysis fit of equations 3, 4 and 6 in this study (Data from Ikwaakor, 1988)

1. <u>Sandstone</u>						
Effective Stress (psi)	Eq.3 Slope Bp	Eq.3 Int. Δ tmp	Eq.4 Slope Bs	Eq.4 Int. Δ tms	Eq.6 Slope Δ tms-(Bs/Bp) Δ tmp	Eq.6 Int. Bs/Bp
500	175.5	49.9	409.1	71.8	-43.0×10^{-6}	2.3
1000	152.8	50.4	353.7	73.3	-42.6×10^{-6}	2.3
2000	130.6	50.5	303.5	72.5	-43.7×10^{-6}	2.3
3000	119.4	50.4	284.5	70.4	-50.6×10^{-6}	2.4
4000	115.3	50.1	279.9	69.3	-50.9×10^{-6}	2.4
5000	113.3	49.8	273.4	68.7	-50.8×10^{-6}	2.4
6000	111.4	49.8	271.9	68.3	-51.2×10^{-6}	2.4
2. <u>Limestone</u>						
500	113.4	52.4	198.5	102.0	7.7×10^{-6}	1.8
1000	86.6	51.6	138.2	98.9	16.3×10^{-6}	1.6
2000	73.8	51.2	114.6	97.4	15.5×10^{-6}	1.6
3000	65.9	50.8	102.6	96.1	14.8×10^{-6}	1.6
4000	60.5	50.5	93.2	95.3	19.6×10^{-6}	1.5
5000	57.2	50.2	87.7	94.5	19.2×10^{-6}	1.5
6000	54.7	50.0	83.6	94.0	19.0×10^{-6}	1.5

Notes: Units of Δ tmp and Δ tms are usec./ft. Units of Bp and Bs are usec./ft./fractional porosity.

This crossplot is based on the linear relationship between interval transit-time (Δt) and porosity (ϕ) (see Eqs. 2 and 3).

c. Acoustic interval transit-time versus bulk density.

This crossplot is based on the linear relationships between Δt and P_b (see Eq. 5).

Concept of Iso-Rock-Property (IRP) Lines

Each of the above crossplots exhibits linear trends or "patterns." In certain cases, the patterns in a crossplot may be easily distinguishable, in which case each pattern represents a single rock-type trend. In most cases, however, data points are linear but widely scattered. This is the case in this study where the reservoir is extremely heterogenous. Straight lines can be constructed, based on experience and knowledge of rock-typing parameters, to represent boundaries of zones of common rock-types. We have coined Iso-Rock-Property (IRP) lines for these lines. IRP lines minimize the need to determine statistical uncertainties of rock-typing parameters since IRP lines can be constructed as close as necessary to each other.

From a practical standpoint, however, it is not possible to draw IRP lines through all data points. Therefore, for practical purposes, we use the bands between adjacent IRP lines. Data points (zones) that fall within the same IRP band are considered to represent the same rock-type for the individual crossplot.

A major flaw with the IRP concept is that the lines are constructed for one fluid condition of the reservoir (e.g. brine in this study). Interpretations are therefore biased for the assumed pore fluid. The presence of a different pore fluid (e.g. gas) would cause the data point (zone) to be "misplaced" relative to where it would be if it were actually brine-saturated.

For purposes of interpretation, this "misplaced" zone would be misinterpreted if it were assumed to be brine-saturated. However, for segregation of rock-types only, it would still be recognized as a different rock-type.

Pb Versus ϕ Crossplot (Figure 12)

For the bulk density versus porosity crossplot, Iso-Rock-Property (IRP) lines were constructed for the following conditions: $P_f = 1.1$ gm/cc, and $P_m = 2.70$ gm/cc, 2.75 gm/cc, 2.80 gm/cc, 2.85 gm/cc and 2.90 gm/cc. These IRP lines delineate six bands or "patterns," coded "1," to "6," in which numbered zones fall. For brine-bearing zones, 1 represents limestone with sand influence or sandstone, mud debris, shale, kerogenite or some unknown lithologic type; 2 represents limestone and limestone with slight dolomite influence; 3 represents partially dolomitized limestone; 4 represents dolomite; 5 represent anhydritic dolomite; and 6 represents pure anhydrite.

Figure 12. Iso-Rock-Property (IRP) lines for bulk density versus porosity crossplot, with data from the Sun Sundsted well.

Since the IRP lines assume brine-saturated rocks, any zones that contain pore fluids with density less than 1.1 gm/cc (e.g. hydrocarbons) would be displaced vertically downward toward lower bulk densities. For gas, the displacement would be appreciable, since gas causes bulk density to decrease. For oil, the displacement may not be large enough to affect the result obtained by assuming brine. Bulk density versus porosity crossplot was used mainly to segregate zones according to grain (matrix) densities, and to infer depositional environments. The crossplot provides the first element in our 3-element rock-typing code system used to identify the numbered zones.

Δt Versus ϕ Crossplot (Figure 13)

The middle IRP line was first constructed using Δt_m (48 usec/ft), and B (70 usec/ft/fractional ϕ) obtained from the Δt versus ϕ crossplot of Melby #4-1 core data at 6500 psi effective stress (Figure 14). Δt_m in the top and bottom IRP lines are 46 usec/ft and 50 usec/ft, respectively, with B kept constant at 70 usec/ft/fractional ϕ . The IRP lines assume brine-saturated rocks.

Zones may plot on any of the four "patterns" or bands coded "A," "B," "C" and "D." This crossplot provides the second element in the 3-element rock-typing code system for identifying the numbered zones. The zones were segregated according to lithology, and grain structure or grain geometry. The crossplot is not as critical as the bulk density versus porosity crossplot for hydrocarbon-bearing zones, because at the depth of the Red River "C" zone, replacement of brine with gas would not cause significant change in the acoustic velocity of the rock.

Δt Versus P_b Crossplot (Figure 15)

In order to construct the IRP lines, Δt_m , B, and P_f were kept constant at 48 usec/ft., 70 usec/ft/fractional ϕ , and 1.1 gm/cc, respectively. From the bottom IRP line to the top, P_m varies, in order: 2.70 gm/cc, 2.80 gm/cc, 2.85 gm/cc and 2.90 gm/cc.

Six "patterns" or bands delineated by the IRP lines are coded "a," "b," "c," "d," "e," and "f." They provide the third element in the 3-element rock-typing code system. Since the IRP lines assume brine-saturated rocks, zones having pore fluids less dense than brine would be displaced in the direction of decreasing bulk density.

Rock-Typing: Analysis and Interpretation

The results of the rock-typing process are tabulated in Table 6, using the Sun Sundsted #1 well, NENW Sec.6 T33N R57E, as an example. Continuous zonation for this well is shown in

Figure 13. Iso-Rock-Property (IRP) lines for interval transit-time versus porosity with data from the Sun Sundsted #1 well.

-----SIP PLOT-----

of
Chevron Melby #4-1
NWSW 1-33N-58E, Sheridan Co., MT

Figure 14. Crossplot of core compressional interval transit-time at 6500 psi effective stress versus core porosity in the Chevron Melby #4-1 key well. Slope = 70.0 usec./ft./fractional porosity; intercept = 48.0 usec./ft.

Figure 15. Iso-Rock-Property (IRP) lines for interval transit-time versus bulk density, with data from the Sun Sundsted #1 well.

Figure 8. Bulk density versus porosity, sonic interval transit-time versus porosity, and sonic interval transit-time versus bulk density crossplots showing the zone numbers are shown in Figures 12, 13, and 15, respectively. Similar crossplots, but without zone numbers, for the rest of the wells used in the study are shown in Appendix C.

In Table 6, zone numbers, as indicated in Figure 8, are shown in column 1. Column 2 is the zone depth interval. The interval thickness is in column 3. Column 4 shows neutron porosity readings. Zone 1 in all the wells is always the "C" anhydrite. The reading for zone 1 (-1.0% in this example) is the number applied to correct neutron porosities for the particular well. Column 5 shows density porosity readings. Column 6 shows corrected neutron porosities. For the anhydrite it is now 0%, since anhydrite is known to have zero porosity. Column 6 is obtained by adding 1% (+1%) to the values in column 4. Column 7 shows "crossplot porosities" used in Figures 12, 13 and 15. These porosities are the average of density porosity (column 5) and corrected neutron porosity (column 6). Crossplot porosity is taken to be zero if this average is zero or negative.

Bulk density, read directly from the density log, is shown in column 8. Bulk density and density porosity are related, but we chose not to use one to obtain the other (using logging parameters of 2.71 gm/cc matrix density, and 1.1 gm/cc fluid density) because of the zonation process. Zonation sometimes involves averaging where a thick log section with constant character is taken as one zone. A consistent character seen on the type log may change as it is correlated to other logs. Examples are zones 28 and 38 in Figure 8.

Interval transit times read directly from the logs are shown in column 9. These readings are thought to be slightly erroneous since the anhydrite zone (zone 1) reads 50.1 usec/ft instead of the 50 usec/ft known from experience. Therefore the anhydrite zone as well as the rest of the zones are corrected by subtracting 0.1 usec/ft from column 9. The result, corrected interval transit-times, is shown in column 10. Column 11 shows the coded rock-types. The coding elements, in order, were obtained from Figures 12, 13 and 15, respectively.

From these three crossplots, zone #6 in the Sun Sundsted #1 well, for example, is coded as rock type 5Df (Table 6, column 11). Zones with similar codes represent the same rock-type.

Altogether, the following 20 different rock-types (codes) were identified in the Sun Sundsted #1 well: 6Df, 5Df, 5Ac, 5Cf, 4Ab, 4Bd, 4Bc, 4Cd, 4Df, 4Ce, 4De, 3Cc, 3Bc, 3Cd, 3Dd, 2Cb, 2Cc, 2Dc, 2Dd, and 2Bb.

The "C" anhydrite interval (zone 1) consists of one rock-type, 6Df, with 0% porosity. Main lithology is anhydrite. The "C" laminated interval (zones 2 to 10) consists of six rock-types: 4Ab, 4Bd, 4Bc, 4Cd, 5Df and 5Ac. The main lithology, dolomite, directly underlies the "C" anhydrite. Two zones, 5Df

Table 6. Example of results from the "rock-typing" process in the Sun Sundsted #1 well.

Well Name: Sun Sundsted #1, NENW 6-33N-57E, Sheridan County, MT

Zone#	Depth	H	ϕ_N	ϕ_D	ϕ_{Nc}	Xplot ϕ	Pb	Δt	Δt_c	Code
1	11200-08	8	-1.0	-10.4	0.0	0.0	2.97	50.1	50.0	6Df
2	11208-12	4	12.0	-0.9	13.0	6.1	2.725	49.1	49.0	4Ab
3	11212-15	3	6.8	-5.4	7.8	1.2	2.80	44.5	44.4	4Ab
4	11215-17	2	23.6	11.0	24.6	17.8	2.53	60.1	60.0	4Bd
5	11217-20	3	19.4	9.5	20.4	15.0	2.56	57.7	57.6	4Bc
6	11220-24	4	29.0	14.0	30.0	22.0	2.49	66.3	66.2	5Df
7	11224-30	6	7.2	-4.3	8.2	2.0	2.785	47.8	47.7	4Bc
8	11230-33	3	24.0	8.1	25.0	16.6	2.58	56.9	56.8	5Ac
9	11233-36	3	12.9	0.7	13.9	7.3	2.70	53.7	53.6	4Cd
10	11236-39	3	18.4	6.0	19.4	12.7	2.61	55.8	55.7	4Bc
11	11239-43	4	4.0	-1.1	5.0	2.0	2.73	49.5	49.4	3Cc
12	11243-44.5	1.5	8.4	2.5	9.4	6.0	2.67	52.0	51.9	3Bc
13	11244.5-48	3.5	2.0	0.7	3.0	1.9	2.70	49.9	49.8	2Cb
14	11248-54	6	3.2	4.0	4.2	4.1	2.645	52.0	51.9	2Cb
15	11254-57	3	2.0	-1.2	3.0	0.9	2.73	49.8	49.7	2Cc
16	11257-59	2	3.5	2.0	4.5	3.3	2.67	50.4	50.3	2Cb
17	11259-62	3	2.0	-1.0	3.0	1.0	2.72	59.6	49.5	2Cc
18	11262-66	4	20.0	10.1	21.0	15.6	2.545	62.5	62.4	4Df
19	11266-69	3	17.0	8.0	18.0	13.0	2.58	59.0	58.9	4Ce
20	11269-72	3	25.3	9.2	26.3	17.8	2.56	62.1	62.0	5Cf
21	11272-75	3	11.5	2.1	12.5	7.3	2.675	55.1	55.0	3Cd
22	11275-77	2	11.7	2.1	12.7	7.4	2.675	56.0	55.9	4De
23	11277-81	4	2.1	-0.1	3.1	1.5	2.71	51.5	51.4	2Dc
24	11281-83	2	6.7	1.4	7.7	4.6	2.685	53.3	53.2	3Dd
25	11283-86	3	1.5	-2.0	2.5	0.3	2.74	50.8	50.7	2Dd
26	11286-88	2	2.3	0.2	3.3	1.8	2.70	51.3	51.2	2Cc
27	11288-90	2	2.3	-2.0	3.3	0.7	2.735	50.0	49.9	2Cc
28	11290-97	7	9.4	0.0	10.4	5.2	2.71	52.6	52.5	3Cd
29	11297-11302	5	1.8	-3.3	2.8	0.0	2.755	48.0	47.9	3Bc
30	11302-06	4	4.0	1.7	5.0	3.4	2.68	52.0	51.9	2Cc
31	11306-11	5	2.0	-1.0	3.0	1.0	2.72	49.8	49.7	2Cc
32	11311-14	3	19.2	8.8	20.2	14.5	2.565	60.4	60.3	4De
33	11314-17	3	14.2	2.5	15.2	8.9	2.66	56.0	55.9	4Ce
34	11317-20	3	1.1	-2.0	2.1	0.1	2.74	48.0	47.9	2Bb
35	11320-23	3	1.0	0.0	2.0	1.0	2.71	48.5	48.4	2Bb
36	11323-24.5	1.5	0.9	-1.9	1.9	0.0	2.74	48.0	47.9	2Bb
37	11324.5-27	2.5	1.1	-0.4	2.1	0.9	2.715	49.5	49.4	2Cb
38	11327-35.5	8.5	1.8	-2.2	2.8	0.3	2.75	49.0	48.9	3Cc
39	11335.5-38	2.5	4.0	-0.5	5.0	2.3	2.72	50.4	50.3	3Cc
40	11338-41	3	1.5	-1.0	2.5	0.8	2.725	48.9	48.8	2Cb
41	11341-46	5	1.0	-4.1	2.0	0.0	2.78	48.3	48.2	3Cc

and 5Ac, are highly porous (16.6% and 22%) anhydritic dolomites. Porosity range in the dolomite is low to high (1.2% to 17.8%). The lower porosity dolomite represents cryptocrystalline dolomite while the higher porosity represents porous dolomite.

The "C" burrowed interval (zones 11 to 41) contains the remaining rock-types: 3Cc, 3Bc, 3Cd, 3Dd, 5Cf, 4Df, 4Ce, 2Cb, 2Cc, 2Dc, 2Dd, and 2Bb. The main lithologies are limestone and dolomitic limestone. Generally, these have low porosities. A few zones of medium to high porosity dolomites and anhydritic dolomites are also present.

Tables similar to Table 6, for the rest of the wells studied, but expanded to include results from quantitative formation evaluation are presented in Appendix E.

If the first element in the 3-element code system for the rock-types were singled out for analysis, we would begin to see possible environmental associations, and a distribution of this element similar to what we observed in the analysis of matrix densities from laboratory measurements. For example, dolomites and anhydritic dolomites underlie the "C" anhydrites, which, in turn, are underlain by mixtures of limestones and dolomitic limestones. The dolomites and anhydritic dolomites that interfinger within the area of dominantly limestones and dolomitic limestones are thought to be permeable burrowed limestones that came in contact with dolomitizing fluids.

Accurate interpretation of the second and third elements within the rock-type codes cannot be made at this time. It will require integrating additional rock-typing criteria, and, possibly, petrographic and other techniques. Information concealed in these elements may include different porosity types, fractures, grain texture and architecture, permeability types, and pore fluid composition.

Important results from this study so far include the ability to segregate and identify rock-types, and show their vertical distribution in the Red River "C" zone carbonates. The results confirm a high degree of heterogeneity in this zone.

Characterization of Dolomite Rock-Types

Dolomite and anhydritic dolomite rock-types, in most wells, underlie the "C" anhydrite. In a few wells, zones of dolomitic limestone directly underlie the anhydrite. Even when they do, they are usually thin. Thicknesses and porosities of the dolomites that underlie the "C" anhydrite vary. In several wells, low porosity dolomites (porosity range 0-3%), the so-called cryptocrystalline dolomites (Longman, Fertal, and Glennie, 1983), directly underlie the "C" anhydrite. In some wells, these dolomites are very thick and continuous beneath the anhydrite. In other wells they are thin, while in still others they interfinger with porous dolomites.

In several other wells porous dolomites directly underlie the anhydrites. These porous dolomites are thin in some wells, and very thick in others, almost representing the entire "C" zone section studied.

Environmental Association of Rock-Types

When we started this project, we expected the degree of heterogeneity that we have reported. The major surprise is the occurrence of well-developed tight (non-porous or very low porosity) dolomites distinctly different from the well-developed porous dolomites. These two types of dolomites were obviously formed under different environments, and, therefore, cannot be lumped together.

If we supported the "upward shoaling" depositional model for the formation of these dolomites, we would have to envisage a supratidal environment where highly saline dolomitizing fluids alternated with less potent dolomitizing fluids to form the tight and porous dolomites, respectfully. This situation would be difficult to explain, especially in those cases where tight dolomites are directly underlain by the porous dolomites, and where tight dolomites are interfingering or interlayered with the porous dolomites.

We did not observe an orderly distribution of the limestones and dolomitic limestones, except that they generally occupy the bottom of the overall carbonate sequence. Environmentally, they would have been deposited in a fluctuating subtidal sea that allowed only partial dolomitization in places. Alternatively, limestone at different times came into contact with much less potent dolomitizing fluids that allowed partial dolomitization of the calcium carbonate in contact with the fluids.

Our results are more in agreement with the general pattern of dolomitization described by some proponents of the "upward-brining" depositional model (Longman, Fertal, and Glennie, 1983). We do not necessarily agree with their mode of dolomitization or the "hole in the anhydrite" entrance for the dolomitizing brines. Moreover, some of the authors themselves are developing alternative theories (Thomas G. Fertal, personal communications).

A viable depositional model cannot be made without first solving the problem of the two dolomites -- tight, low porosity dolomite rock-types and the porous dolomite rock-types -- which randomly underlie the "C" anhydrite, and, in other places, interlayered with dolomitic limestones and limestones. An approach that comes to mind is to determine patterns of structural growth during the deposition of the Red River "C" zones by making some isopach maps, using distinguishable time markers within the "C" zone itself. Such effort is beyond the scope of this project.

Because of the above-mentioned obstacles, no reasonable statistical analysis of the rock-typing results can be made at this time to determine association of rock-types and environmental units.

Stratigraphic Cross-sections (PLATE 1)

Two intersecting stratigraphic cross-sections in the North-South and East-West directions (Figure 4) were made in an attempt to gain partial understanding of the lateral relationships and a deeper understanding of the vertical relationships of rock-types and porosity development. In order to have a fuller understanding of lateral relationships, a closer spacing of the wells would be necessary.

These cross-sections (Plate 1)* do not necessarily represent other cross-sections that may be made in the northern, western or eastern borders of the study area. However, they contain useful characteristics that can be exploited toward satisfying some EOR objectives, namely, in-fill drilling and identification of by-passed reserves.

Both cross-sections have been color-coded by lithologic type (first element of the rock-type code) and porosity. The color codes are used mainly to show the tremendous potential for stratigraphic trapping, especially for dolomites and anhydrotic dolomites. The best reservoirs are developed around the crests of structural closures. Structural position rather than proximity of wells determines reservoir quality.

For example, in the E-W cross-section, the Stevens Sweet River 1-10-2B dry well, NENE 10-32N-57E, is about 1/3 mile and 83 feet lower than the Stromberg No. 1 high producer, NENW 11-32N-57E. The other good producer, the FLB-Peterson No. 1, is over one mile east of the Stromberg well but only nine feet lower. In the N-S cross-section, structural reversal invariably signals termination of good reservoir conditions (combination of permeability barrier and low porosity). For example, the Marie Stromberg No. 1-2-4C well is dry, 16 feet lower, and only 1/4 mile north of the Stromberg No. 1 good producer. The porous anhydritic dolomites and dolomites in the Stromberg No. 1 producer are rapidly replaced by cryptocrystalline dolomites and anhydritic dolomites. We believe that, although Stromberg No. 1 does not occupy the highest structural position, its good production results from combined structural and stratigraphic trapping.

These observations are important for choosing the locations for in-fill drilling or determining directions for additional development wells and new exploration targets, especially those stratigraphically trapped as a result of updip and lateral porosity pinch-out.

*This plate is available on request from the Office of Scientific and Technical Information, P.O. Box 62, Oak Ridge, Tennessee 37831 for the price of copying. Phone (615) 576-8401 for prices.

CHAPTER 5 - QUANTITATIVE FORMATION EVALUATION

Processes of Formation Evaluation

Archie's (1942) resistivity equation is the basis for quantitative formation evaluation to determine water saturations:

$$R_t = \phi^{-m} R_w S_w^{-n} \dots\dots\dots(7)$$

or

$$S_w = [(\phi^{-m} R_w)/(R_t)]^{1/n} \dots\dots\dots(8)$$

R_t is true formation resistivity, ϕ is true fractional porosity, R_w is formation water resistivity, S_w is water saturation, m is cementation factor, and n is saturation exponent.

Log measurements of porosity and resistivity were found to be erroneous in several wells. Porosities were initially corrected as described in the previous chapter before being used in the above equations to determine water saturations.

The Stony Mountain Shale (Ordovician) which overlies the Red River Formation was used to detect measurement problems in the resistivity logs. Lack of quantitative agreement between the flushed zone resistivity (R_{xo}) and the apparent formation resistivity (R_{ta}) in the Stony Mountain Shale was regarded as a symptom of error. The "Correction Factor" (CF) applied was the ratio of the R_{xo} reading to the R_{ta} reading in the Stony Mountain Shale. CF's ranging from 0.38 to 1.29 ohm-m were applied to correct erroneous resistivity logs [correct resistivity, $R_{tc} = R_{ta} \times CF$].

Three approaches were considered in determining water saturation:

1. Substitute estimates of porosity (ϕ), formation resistivity (R_t) formation water resistivity (R_w), cementation factor (m), and saturation exponent (n) into Eq. 8.
2. Use the comparative approach (the so-called "Pickett-plot") and bulk density from the density log. For example, the equation for bulk density is:

$$P_b = P_m (1 - \phi) + P_f \phi \dots\dots\dots(9)$$

where P_m is matrix density and P_f is fluid density. Elimination of the common variable, ϕ , between Eq. 7 and Eq. 9 leads to:

$$\text{Log } R_t = -m \text{ Log}(P_m - P_b) + m \text{ Log}(P_m - P_f) + \text{Log } R_w + \text{Log } S_w^{-n} \dots\dots(10)$$

This is the equation for a family of parallel straight lines for a graph of $\log R_t$ versus $\log (P_m - P_b)$. The quantity S_w^{-n} can be extracted from such a plot without prior knowledge of m , P_m , P_f or R_w . The value of S_w obtained is virtually independent of

systematic error in the measurement of Rt or Pb.

This approach was rejected because of the wide variability in matrix densities indicated in the earlier chapters of this report. This approach could, however, be used if the only targets were the dolomite and anhydritic dolomite reservoirs. In this situation, a matrix density value of 2.85 gm/cc could be used, after applying porosity cut-off to eliminate unwanted zones.

3. Use the comparative approach and interval transit-time (Δt) from acoustic (sonic) logs.

An analogous equation for resistivity coupled with acoustic logs is:

$$\log R_t = -m \log (\Delta t - \Delta t_m) + m \log B + \log R_w + \log S_w^{-n} \dots (11)$$

where Δt is interval transit-time from the sonic log, Δt_m is transit-time of the matrix material, B is constant dependent on lithology, effective stress, and grain contact area.

This approach was rejected because of the variability in Δt_m indicated in the rock-typing section of the previous chapter. Nevertheless, it was our second choice because the variability in Δt_m was much less than that for matrix densities. Moreover, values of Δt_m and B that were successfully applied in rock-typing were already available. The greatest problem would have come from the selection of water-bearing trends in the Pickett-plot, especially if porosity cut-off was not used.

It was because of the potential problems in the use of either bulk densities or acoustic interval transit-times, and the relative success of our rock-typing processes, that led us to the combined use of Eq. 8 and the Pickett-plot.

The porosity that was entered in Eq. 8 was the same cross-plot porosity used to discriminate rock-types. The resistivity was the corrected resistivity described earlier in this chapter.

Based on prior experience in the Red River carbonates, values of cementation factor and saturation exponent were assumed to be 2. A value of 0.018 ohm-meter for formation water resistivity was chosen in part from past experience and in part from measurements reported in some of the wells studied.

Equation 7 can be rewritten as follows:

$$\log R_t = -m \log \phi + \log R_w + \log S_w^{-n} \dots (12)$$

This equation represents a family of straight lines with constant R_w in a plot of $\log R_t$ versus $\log \phi$. A log-log crossplot of porosity versus resistivity (Pickett-plot) was used to determine water saturations and to show the distribution of data points relative to lines of constant water saturation. An

in-house computer program, PICKETT.BAS, was used. Figure 16 is a typical crossplot made for the Sun Sundsted #1 well. Similar crossplots for the rest of the wells studied are shown in Appendix D.

Prior knowledge of formation water resistivity (R_w) and cementation factor (m) made the determination of S_w simpler and more accurate. It prevented us from attempting to establish the water-bearing trend (100% S_w line) by eye. Judging from the position of computer generated water-bearing line, we would have been in error in several wells if we had attempted to establish the line in each well by eye.

Results of Quantitative Formation Evaluation

We consider the process and results of quantitative formation evaluation the highlights of this study. All the producing zones were confirmed; they all calculated favorable water saturation (not greater than 50%). This confirmation led us to believe that other zones that calculated favorable water saturations, but were not produced, represent by-passed reserves. Bypassed reserves exist in several producing wells as well as wells designated Plugged-and-Abandoned. Using a cut-off water saturation of 50%, and drainage area of 640 acres (spacing for Red River wells), total bypassed Oil-in-place (OIP) was estimated at over 150 million barrels. This estimate was calculated using the equation:

$$OIP = c \sum (S_o \phi h) \times DA \text{ barrels}$$

where, S_o is oil saturation. Under the assumption of a two-phase fluid system (appropriate for the Red River "C" zone in the study area), $S_o = 1 - S_w$; ϕ is by-passed zone porosity; h is the corresponding zone thickness; DA is "drainage area;" and $c = 7758$ barrels/acre-ft. The summation sign, $\sum$, is introduced to indicate that OIP was the sum of oil-in-place from all zones of individual thicknesses, h .

We consider this estimate of by-passed OIP to be on the high end because many of the potential by-passed zones have marginal water saturations. These marginal zones would all be eliminated from our calculations if, instead of using $R_w = 0.018$ ohm-m, we used $R_w = 0.023$ ohm-meter which was measured in the Haaven #1-25 well, NW Sec. 25 T34N R58E, Sheridan County Montana.

Quantitative formation evaluation also provided pitfalls in using the Pickett-Plot to evaluate the Red River "C" zone. Although the producing zones, as expected, calculated favorable water saturations, there were also zones that calculated water saturations greater than 100%. These zones, usually, have low porosities and relatively high resistivities. In order to avoid such zones, and for better selection of the water (100% S_w) trend without prior knowledge of formation water resistivity (R_w) and cementation factor (m), it is important to establish a cut-off for porosities.

Figure 16. Example crossplot of $\log R_t$ versus $\log \phi$ for the Sun Sundsted #1 well, new 6-33N-57E.

CHAPTER 6 - INTEGRATION OF RESULTS FROM ROCK-TYPING AND QUANTITATIVE FORMATION EVALUATION

Table 7 is an example of the combined results of the rock-typing process and quantitative formation evaluation for the Sun Sundsted #1 well, NENW Sec.6 T33N R57E.

Column 12 is apparent formation resistivity or the resistivity value read directly from the resistivity log. Column 13 is the correction factor (CF) applied to correct apparent resistivities. Column 14 is the corrected formation resistivity (R_{tc}) obtained as the product of columns 12 and 13. Column 15 is percentage water saturation obtained from the log-log crossplot of R_{tc} versus crossplot porosity from column 7. Column 16 shows zones (depth interval) tested by Drill Stem Testing (DST). Column 17 shows zones (depth intervals) perforated by the well operator. Column 18 shows calculated by-passed reserves (OIP in thousand barrels of oil) in the zones identified as by-passed.

The operator of the Sun Sundsted #1 well, for example, perforated all the high porosity intervals. This practice is common for most Red River wells because no consistent or reliable formation evaluation process existed.

Dolomite and anhydritic dolomite rock-types have the best porosities, and make the best reservoirs. In some wells, limestones and dolomitic limestones with low porosities also calculated favorable water saturations. Most of these low porosity zones were by-passed. They may not have produced good "shows" during drilling to attract further testing. Therefore, if these tight zones contain oil as they have calculated, they may only produce through reservoir enhancement.

The results shown in Table 7 for the Sun Sundsted #1 well are similar to results obtained in other wells, and will be used as reference for discussing the results of this study. The wide variability of rock-types and associated porosities are indicative of complex heterogeneity in the Red River "C" zone carbonates. Considering only the first element of the 3-element code, the vertical distribution of the rock-types is generally consistent with what is known from published literature (Longman, Fertal, and Glennie, 1983). Dolomites are underneath the wide-spread "C" anhydrite. Dolomitic limestones and limestones occupy the bottom of the sequence. This result validates the usefulness of the bulk density versus porosity crossplot in rock-typing. In greater detail, however, the vertical sequence is not as orderly. Dolomites often occur where limestones and dolomitic limestones are predominant. In other cases, dolomitic limestones directly underlie the "C" anhydrite.

Complexities emerge when the second and third code elements are involved. Our initial expectation was that rock-types would be discriminated in a systematic manner so that any one rock-type

Table 7. Example of the combined results of the "rock-typing" process and quantitative formation evaluation in the Sun Sundsted #1 well.

Well Name: Sun Sundsted #1, NENW 6-33N-57E, Sheridan County, MT
IP: IPF 334 BOPD, 411 MCFGPD, 55 BWPD

Zone#	Depth	H	φN	φD	φNC	Xplot	φ	Pb	Δt	Δtc	Code	Rt	CF	Rtc	Sw%	DST	Perf.	By-passed Reserve OIP(MBO)
1	11200-08	8	-1.0	-10+	0.0	0.0	2.97	50.1	50.0	6Df	5000	0.82	4100	2095				
2	11208-12	4	12.0	-0.9	13.0	6.1	2.725	49.1	49.0	4Ab	24	0.82	19.7	49		Yes		617.2
3	11212-15	3	6.8	-5.4	7.8	1.2	2.80	44.5	44.4	4Ab	80	0.82	65.6	138		Yes		
4	11215-17	2	23.6	11.0	24.6	17.8	2.53	60.1	60.0	4Bd	1.8	0.82	1.5	61		Yes		
5	11217-20	3	19.4	9.5	20.4	15.0	2.56	57.7	57.6	4Bc	4.0	0.82	3.3	49		Yes		
6	11220-24	4	29.0	14.0	30.0	22.0	2.49	66.3	66.2	5Df	3.2	0.82	2.6	37		Yes		
7	11224-30	6	7.2	-4.3	8.2	2.0	2.785	47.8	47.7	4Bc	34	0.82	27.9	127				
8	11230-33	3	24.0	8.1	25.0	16.6	2.58	56.9	56.8	5Ac	10.3	0.82	8.5	27		Yes		
9	11233-36	3	12.9	0.7	13.9	7.3	2.70	53.7	53.6	4Cd	50	0.82	41.0	28		Yes		
10	11236-39	3	18.4	6.0	19.4	12.7	2.61	55.8	55.7	4Bc	24	0.82	19.7	23		Yes		
11	11239-43	4	4.0	-1.1	5.0	2.0	2.73	49.5	49.4	3Cc	20	0.82	16.4	165				
12	11243-44.5	1.5	8.4	2.5	9.4	6.0	2.67	52.0	51.9	3Bc	10	0.82	8.2	78				
13	11244.5-48	3.5	2.0	0.7	3.0	1.9	2.70	49.9	49.8	2Cb	50	0.82	41.0	110				
14	11248-54	6	3.2	4.0	4.2	4.1	2.645	52.0	51.9	2Cb	31	0.82	25.4	64				
15	11254-57	3	2.0	-1.2	3.0	0.9	2.73	49.8	49.7	2Cc	130	0.82	106.6	144				
16	11257-59	2	3.5	2.0	4.5	3.3	2.67	50.4	50.3	2Cb	60	0.82	49.2	57				
17	11259-62	3	2.0	-1.0	3.0	1.0	2.72	59.6	49.5	2Cc	100	0.82	82.0	148				
18	11262-66	4	20.0	10.1	21.0	15.6	2.545	62.5	62.4	4Df	2.9	0.82	2.4	55		Yes		
19	11266-69	3	17.0	8.0	18.0	13.0	2.58	59.0	58.9	4Ce	3.0	0.82	2.5	65		Yes		
20	11269-72	3	25.3	9.2	26.3	17.8	2.56	62.1	62.0	5Cf	2.0	0.82	1.6	59		Yes		
21	11272-75	3	11.5	2.1	12.5	7.3	2.675	55.1	55.0	3Cd	6.0	0.82	4.9	83				
22	11275-77	2	11.7	2.1	12.7	7.4	2.675	56.0	55.9	4De	6.0	0.82	4.9	81				
23	11277-81	4	2.1	-0.1	3.1	1.5	2.71	51.5	51.4	2Dc	70	0.82	57.4	118				
24	11281-83	2	6.7	1.4	7.7	4.6	2.685	53.3	53.2	3Dd	10.9	0.82	8.9	97				
25	11283-86	3	1.5	-2.0	2.5	0.3	2.74	50.8	50.7	2Dd	270	0.82	221.4	300				
26	11286-88	2	2.3	0.2	3.3	1.8	2.70	51.3	51.2	2Cc	80	0.82	65.6	92				
27	11288-90	2	2.3	-2.0	3.3	0.7	2.735	50.0	49.9	2Cc	140	0.82	114.8	178				
28	11290-97	7	9.4	0.0	10.4	5.2	2.71	52.6	52.5	3Cd	11	0.82	9.0	86				
29	11297-11302	5	1.8	-3.3	2.8	0.0	2.755	48.0	47.9	3Bc	210	0.82	172.2	10223				351.1
30	11302-06	4	4.0	1.7	5.0	3.4	2.68	52.0	51.9	2Cc	80	0.82	65.6	48				
31	11306-11	5	2.0	-1.0	3.0	1.0	2.72	49.8	49.7	2Cc	120	0.82	98.4	135				
32	11311-14	3	19.2	8.8	20.2	14.5	2.565	60.4	60.3	4De	3.0	0.82	2.5	58		Yes		
33	11314-17	3	14.2	2.5	15.2	8.9	2.66	56.0	55.9	4Ce	4.0	0.82	3.3	82		Yes		
34	11317-20	3	1.1	-2.0	2.1	0.1	2.74	48.0	47.9	2Bb	100	0.82	82.0	1481				
35	11320-23	3	1.0	0.0	2.0	1.0	2.71	48.5	48.4	2Bb	90	0.82	73.8	156				
36	11323-24.5	1.5	0.9	-1.9	1.9	0.0	2.74	48.0	47.9	2Bb	210	0.82	172.2	10223				
37	11324.5-27	2.5	1.1	-0.4	2.1	0.9	2.715	49.5	49.4	2Cb	110	0.82	90.2	156				
38	11327-35.5	8.5	1.8	-2.2	2.8	0.3	2.75	49.0	48.9	3Cc	40	0.82	32.8	780				
39	11335.5-38	2.5	4.0	-0.5	5.0	2.3	2.72	50.4	50.3	3Cc	14	0.82	11.5	172				
40	11338-41	3	1.5	-1.0	2.5	0.8	2.725	48.9	48.8	2Cb	43	0.82	35.3	282				
41	11341-46	5	1.0	-4.1	2.0	0.0	2.78	48.3	48.2	3Cc	70	0.82	57.4	17708				

could be traceable and uniquely characterized over a large area. But this was not the situation.

For example, zones 2 and 3 in Table 7 have the same rock-type code, 4Ab, and therefore represent the same rock-type. But while zone 2 calculates favorable (though marginal) water saturation, zone 3 does not. Again, zones 5, 7 and 10 have the same code, 4Bc, and also represent the same rock-type. While zone 10 calculates 23% water saturation, zone 5 calculates 49%, and zone 7 calculates 127%. Therefore, for the Red River "C" zone, we cannot use these 3-element rock-types alone to determine reservoir quality.

While all these zones mentioned are dolomite rock-types, those with favorable water saturations have higher porosities than the zones that have unfavorable water saturations. If we set a cut-off porosity of, say, 10% prior to analysing the well, zones 2, 3, and 7 would not have been considered at all, and the rock-types 4Ab and 4Bc would more consistently represent reservoir rock-type.

The case described here, where there is multiple occurrence of the same rock-type with inconsistent water saturations, is common in other wells. Having a cut-off porosity tends to produce better correlation between rock-types and their fluid saturations.

Grading of Reservoir Rock-Types

Without the option of porosity cut-off, forty-six different rock-types (codes) have favorable water saturations (S_w not greater than 50%) and are considered reservoir rock-types. Table 8 lists the reservoir rock-types and their properties. The total thickness of each reservoir rock-type determined from all the wells studied is shown in column 3. Columns 4 and 5 show the average porosity and water saturation, respectively, determined for each of the rock-types. Column 6 shows the number of zones that contributed to the calculated averages. Column 7 shows the number of those zones that occurred in perforated and producing intervals. Column 8 shows the number of unperforated zones. Columns 9 and 10 contain the ranges of porosity and water saturation encountered in each reservoir rock-type.

The reservoir rock-types are characterized by wide ranges in porosity and water saturation. Judging from the number that were perforated, anhydritic dolomite and dolomite rock-types have the best combinations of porosity and water saturation, and contributed the bulk of oil production. The unperforated zones constitute by-passed reserves. It is also possible that some of the rock-types, especially those with low porosities, may not have contributed any oil, even though they were in the intervals perforated.

Individually, some of the rock-types are better and more consistent reservoirs than others. For example, rock-types 5Bd, 5Ce, 5Cf, and 5Df (all anhydritic dolomites) are the most

Table 8. Reservoir rock-types and their properties

No.	Code	H	Ø	Sw	Total Zones	No. Perf'd	No. Unperf'd	Porosity Range	Sw range
1	6Ac	4	16.6	40	1	0	1		
2	6Ad	2.5	14.1	47	1	0	1		
3	6Ae	2	13.9	18	1	0	1		
4	6Be	1	11.9	24	1	1	0		
5	6Cf	3	22.2	46	1	0	1		
6	5Aa	4	30.3	22	1	0	1		
7	5Ac	35.5	10.5	34.2	10	3	7	4.4-16.6	15-50
8	5Ad	10.5	16.2	38.5	4	2	2	14.9-18.5	27-50
9	5Ba	3	26.5	50	1	0	1		
10	5Bd	23.5	13.3	34.9	8	5	3	6.6-20.4	21-47
11	5Be	21	16.4	31.3	3	1	2	8.2-21.9	13-50
12	5Cd	2	19.5	17	1	1	0		
13	5Ce	29.5	17.3	29.9	10	6	4	13.4-21.9	20-50
14	5Cf	18.5	20	31.6	5	4	1	15.1-24.4	14-46
15	5Df	39	20.6	25.6	13	12	1	8.0-31.0	12-41
16	4Aa	5.5	13.7	27.0	2	0	2	8.3-19.1	23-31
17	4Ab	61	6.2	37.4	20	1	19	1.1-10.4	18-50
18	4Ac	27	8.7	39.8	12	1	11	3.2-16.4	26-50
19	4Ad	4	11.2	48	1	0	1		
20	4Bc	63.5	10.8	33.3	19	5	14	1.9-23.7	18-49
21	4Bd	57.5	12.5	30.8	20	6	14	5.4-20.5	14-50
22	4Cd	39	10.7	32.4	15	6	9	4.5-18.9	21-50
23	4Ce	23	17.1	28.8	8	4	4	9.2-22.5	14-35
24	4Dd	6	10.7	26	1	1	0		
25	4De	15.5	14.1	27.2	6	2	4	5.9-20.4	18-38
26	4Df	45	14.2	36.2	12	5	7	4.9-25.3	22-49
27	3Aa	27	7.3	32.5	8	1	7	4.0-12.5	26-46
28	3Ab	37	6.5	42.2	14	0	14	2.6-17.0	25-50
29	3Bb	12	7.4	36.6	5	2	3	4.1- 8.7	20-48
30	3Bc	23	7.2	33.8	6	1	5	4.6-11.0	19-48
31	3Cc	22.5	5.1	33.3	8	0	8	2.3- 8.2	11-48
32	3Cd	27	6.1	41.5	11	3	8	1.2-15.0	25-50
33	3Dd	3	7.8	24	1	0	1		
34	3De	1.5	6.5	35	1	0	1		
35	3Df	8	19.6	36.5	2	1	1	15.2-23.9	23-50
36	2Aa	5.5	8.4	29.7	3	1	2	2.2-17.2	19-45
37	2Ba	33	2.5	33.3	6	0	6	0.4- 4.4	16-49
38	2Bb	11.5	1.7	24.3	3	0	3	0.4- 3.7	8-46
39	2Cb	21.5	3.8	38.7	9	1	8	0.2- 9.8	25-49
40	2Cc	8.5	3.6	31.3	3	0	3	1.9- 5.6	3-48
41	2Cd	3.5	10.9	17	1	1	0		
42	2Dc	3.5	3.0	45	2	0	2	2.8- 3.1	42-18
43	2Dd	1.5	4.8	44	1	0	1		
44	2De	5.5	4.5	45.3	3	0	3	3.5- 6.6	40-49
45	1Ba	4	1.4	11	2	0	2	1.4- 1.4	7-15
46	1Dd	2.5	4.1	25	1	0	1		

consistent producers. Others are 4Bc, 4Bd, 4Ce, 4Cd and 4Df (all dolomites). While 5Df, may not be the best reservoir, it stands out as the most consistently perforated. In all the wells where it calculated favorable water saturation, only one zone was by-passed.

The rock-type thickness, average porosity and average water saturation are plotted in a histogram in Figure 17. The best reservoirs are those with the highest porosities and lowest water saturations. In Figure 17, these reservoirs have the least separation between the porosity and the water saturation lines. Examples are 5Aa, 5Cd, 5Df, 5Cf, and 5Ce.

Figure 18 is a crossplot of average water saturation versus average porosity for the reservoir rock-types shown in Table 8. The Bulk Volume Water (BVW) curves were preconstructed before the data points were plotted ($BVW = "c" = S_w \times \phi$). Since the curves are permeability indicators, the crossplot was used to provide qualitative grading of the reservoir rock-types. BVW curves assume irreducible water saturation.

Based on the low water production in most of the wells, it is safe to assume irreducible water saturation for the reservoir rock-types. The crossplots therefore show the distribution of forty-six reservoir rock-types with different producibility potentials.

The best reservoirs are in the direction of decreasing BVW value. Also for each curve, permeability increases from the bottom to the top, corresponding to increasing porosity and decreasing water saturation. For example, in Figure 18, on the BVW curve where $"c" = 0.03$, the increasing order of reservoir quality for the data points (rock-types) is: 28(3Ab), 29(3Bb), 36(2Aa), 24(4Dd), 4(6Be), 3(6Ae), and 12(5Cd). This order corresponds to increasing permeability or the ability of the reservoir to produce oil. For the following data points (rock-types) that may have equal permeabilities, the increasing order of reservoir quality is: 5(6Cf), 14(5Cf), 15(5Df), and 12(5Cd). This means that for the same thickness of reservoir, 5Cd will produce the most oil among 5Df, 5Cf and 6Cf.

Multiplicity of Reservoir Rock-Types: Discussion

Without porosity cut-off, the number of reservoir rock-types identified (forty-six) is unexpectedly high. On first review, this large number tends to dispute our initial introduction and definition of the "rock-type." We had indicated that only one or two reservoir rock-types produce the bulk volume of hydrocarbons in a given formation.

Twenty-six out of the forty-six reservoir rock-types occur at least once in perforated intervals. Nine out of the twenty-six are dolomite rock-types, and nine are anhydritic dolomite rock-types. Five are dolomitic limestone rock-types, and three are limestone.

Figure 17. Histogram of total thickness, average porosity, and average water saturation

Figure 18. Bulk Volume Water (BVW) curves used to grade reservoir rock-types listed in Table 8

With a porosity cut-off of 10%, only thirteen reservoir rock-types are eliminated, mainly limestones and dolomitic limestones.

The following may explain the wide variability and multiplicity of rock-types identified in the study:

1. Use of multiple criteria to identify rock-types

Each of the three elements used in the rock-type code could be used in isolation to recognize rock-types. If the first element was used, we would have only seven different rock-types, and six reservoir rock-types. Only two of these rock-type codes, "4" and "5" (dolomite and anhydritic dolomite) would contribute the bulk of oil produced.

If the first two elements were used, we would have twenty-six reservoir rock-types instead of the forty-six we have by using all three elements. Again the bulk of oil production would come from anhydritic dolomite and dolomite rock-types, namely, 5A, 5B, 5C, 5D, 4C, and 4D (see Table 8). What is wrong with these rock-types is that they are not definitive enough. One would depend on luck if one went along and completed all 5A's or 5C's or 4D's because some of these are not good reservoir rock-types.

With three rock-type codes, a better refinement and selection of the reservoir rock-types is achieved, such as, 5Ad, 5Bd, 5Cd, 5Ce, 5Cf, 5Df, 4Ce, and 4Df (not just all 5A's, or 5B's, or 5C's, or 5D's or 4C's or 4D's). This means that these eight reservoir rock-types have the best chance to produce oil when they calculate favorable water saturation. What we gain by using multiple rock-typing criteria is to improve the statistical chance of producing oil when a zone calculates favorable water saturation.

To demonstrate how this progression occurs, if we had only the bulk density versus porosity crossplot, and we had to select the two best reservoir rock-types, the best two choices would be anhydritic dolomite and dolomite reservoir rock-types. Without additional information, we would be grossly in error in making the selection because not all dolomite or anhydritic dolomite rock-types are of reservoir quality. For those that are, there are several grades.

When the interval transit-time versus porosity crossplot is added, the best two reservoir rock-types would be 5C and 5D (see Table 8). Dolomites are eliminated, and we are left with two classes of anhydritic dolomites. Within these two classes are still many lower grade reservoir rock-types which can be identified and eliminated only with the integration of another rock-typing criterion.

With the three crossplots used in this study, the best two choices of reservoir rock-types from the two classes above would be 5Cf and 5Df (Table 8). The selection could be refined further

by integrating other rock-typing criteria not applied in this study.

2. Sensitivity of the rock-typing and formation evaluation processes.

Rock samples in hand specimen, especially the washed core plug samples, show such complexity and changes, even at one-foot intervals, that would be difficult to resolve with the most sensitive logging devices. It seems that the multiplicity of rock-types revealed through this study is accurate.

Our choice of formation water resistivity may also have contributed to the many reservoir rock-types identified. A higher formation water resistivity (e.g. 0.023 ohm-m measured in the Haave #1-25 well) would eliminate most marginal reservoir rock-types (water saturation between 45% and 50%).

3. Uncertainty concerning the second and third elements in the 3-element code system.

Parameters derived in the key well were used in 52 well locations, some far removed from the key well. It is a matter of conjecture whether the results would have been different if the wells were more localized and closer together (e.g. field scale), or if we chose other parameters that represented carbonates universally, instead of the parameters from the key well? This matter would only be resolved if results obtained from using other parameters were compared with the results from this study. If we obtained equally reliable results by using other parameters, instead of those obtained from core measurements, then transferability of the rock-typing process would be easy. Costly laboratory core measurements would also be eliminated.

The most suspect element in the code system is the third element. This is because, in constructing the IRP lines, we varied only matrix density while keeping coefficients Δt_m and B constant. Although the Δt versus porosity crossplot (source of the second element) produced the narrowest scatter of points among the three rock-typing crossplots, it still had enough scatter to provide the variability exhibited in the second element.

Despite this uncertainty in the second and third elements in the rock-type code, we still believe that results obtained with them should be consistent. Since nothing was done to alter the positions of the data points themselves, only their position relative to the IRP lines was relevant.

4. Open-ended IRP lines and patterns

In retrospect, IRP lines should have been constructed to cover all possible data points. As presently constructed, the end patterns or IRP bands (e.g. "1" and "6", "A" and "D", and "a" and "f") had to accommodate data points that would otherwise belong in other IRP bands if the IRP lines were expanded beyond

their present limits. It is because of this limitation that we see porous and reservoir rock-types having code 6 as their first element (e.g. 6Ac, 6Ad, 6Ae, 6Be, and 6Cf, in Table 8). Originally, code 6 was reserved for the tight "C" anhydrite only.

The above discussion touches on what might be considered anomalous results, and what might have contributed to the wide variability of rock-types observed in this study. The Red River "C" zone carbonates are, in fact, extremely heterogenous, as evidenced by the several crossplots presented, and also by observations made in hand specimen. The wide variability of rock-types, and the multiple reservoir rock-types may be the actual situation in the Red River "C" zone carbonates. Identification of multiple reservoir rock-types was achieved through progressive breakdown and grading of the reservoir effected by using multiple rock-typing criteria.

CHAPTER 7 - CONCLUSIONS AND RECOMMENDATIONS

The Ordovician Red River "C" zone carbonates are extremely heterogenous. The heterogeneity occurs in the following elements: multiple lithologic types, porosity, permeability, pore fluid composition/distribution, lithologic (rock-type) distribution, and depositional environment.

Seven different lithologic types and sixty-four (64) different rock-types were identified. Forty-six (46) of the rock-types either produce or have the potential to produce oil in different wells. Many rock-types which were not reservoir quality in some wells, developed reservoir quality in others. Because of this, pore fluid composition was not an important factor in discriminating the "C" zone carbonate rock-types.

The lithologic types were identified through the first element in the 3-element code system of distinguishing rock-types. The lithologic types and their associated heterogeneities are summarized below:

<u>Lithologic code</u>	<u>Characteristics</u>
6	Anhydrites: one rock-type, tight, widespread.
6	Anhydritic dolomite: tight, low and high porosities, seven different rock-types, five rock-types calculate favorable water saturation in one or more wells.
5	Anhydritic dolomite: tight, low, medium and high porosities, 13 different rock-types, 10 calculate favorable water saturation in one or more wells.
4	Dolomite: tight, low, medium and high porosities, 14 different rock-types, 11 calculate favorable water saturation in one or more wells.
3	Dolomitic limestone: tight, low and medium porosities, 12 different rock-types, nine calculate favorable water saturation in one or more wells.
2	Limestone: tight, low porosities, 13 different rock-types, nine calculate favorable water saturation in one or more wells.

Lithologic Code cont.

Characteristics

1

Kerogenite or sandstone or arenaceous limestone: tight, very low porosities, four different rock-types, two calculate favorable water saturation in one or more wells.

Detailed interpretation of heterogeneities in the second and third elements of the rock-type code system is beyond the scope of the present study. It would require integrating more rock-typing criteria, and petrographic data. It is safe, however, to assume that the heterogeneities observed in porosities, permeabilities and, possibly, pore fluid composition/distribution, are also embedded in those two elements.

The only permeability data was measured in the key well by the well operator, Chevron USA, Inc. In general, lower permeabilities were associated with lower porosities, and higher permeabilities with higher porosities. There were few cases where high porosity zones had corresponding low permeabilities, and vice versa, probably due to diagenetic characteristics.

In several wells, widely separated zones produce or have the potential to produce oil. This implies the occurrence of multiple oil/water contacts or compartmentalized reservoirs.

Rock-typing is an important process for discriminating and quantifying lithologic heterogeneities. Its greatest advantage is that it is economical because it uses routine well logs. Rock-typing can be expanded beyond the three rock-typing criteria used in this study. It can include the other rock-typing criteria identified early in the study. Its usefulness can be enhanced by integrating the techniques with other disciplines, and reservoir characterization techniques. By so doing, a more definitive identification of the most favorable reservoir rock-types can be made for EOR projects.

For example, by involving quantitative formation evaluation, it was possible to extract more information than if only the results from rock-typing were considered in isolation. The techniques applied in the characterization of the Red River "C" zone carbonates can be applied to other carbonate sequences, with, perhaps, slight modifications in the construction of the Iso-Rock-Property (IRP) lines.

This study is considered regional in scope. Other similar studies should incorporate as much data and as many wells as possible in order to better predict interwell heterogeneities and relationships. Even though we were limited in the number of wells studied, the positive results from the regional study should lead to more successful field scale studies for EOR modeling and EOR pilot projects.

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APPENDIX A

Laboratory Rock Property Measurements
Well: Chevron Melby #4-1
NWSW Sec. 1 T33N R58E
Brush Lake Field
Sheridan County, Montana

Table A-1: Laboratory Rock Property Measurements.

Contractor:	Contract: DE-AC22-91BC14655
Ikwuakolam Energy Company, Inc.	Well: Chevron Melby 4-1
2413 Washington Street	NWSW Sec 1 T33N R58E
Denver, Colorado 80205	Brush Lake Field
	Sheridan County, Montana

ROCK PROPERTY MEASUREMENTS

(POROSITY, DENSITY, COMPRESSIONAL AND SHEAR WAVE SLOWNESS AND VELOCITY)

Conf. Press.	Pore Press.	Effect. Press.	Delta tp	Delta ts	Comp. Velocity	Shear Velocity
-----	psi	-----	---- usec/ft	----	----- ft/sec	-----
Sample: 11272 Porosity: 0.001 Bulk Density: 2.939						
700	200	500	4.99E+01	1.07E+02	2.00E+04	9.31E+03
1,700	200	1,500	4.97E+01	1.06E+02	2.01E+04	9.45E+03
3,700	200	3,500	4.95E+01	1.03E+02	2.02E+04	9.67E+03
6,700	200	6,500	4.93E+01	1.02E+02	2.03E+04	9.77E+03
700	200	500	4.99E+01	1.07E+02	2.00E+04	9.37E+03
Sample: 11273 Porosity: 0.001 Bulk Density: 2.945						
700	200	500	5.05E+01	1.18E+02	1.98E+04	8.49E+03
1,700	200	1,500	4.99E+01	1.06E+02	2.00E+04	9.46E+03
3,700	200	3,500	4.92E+01	1.05E+02	2.03E+04	9.54E+03
6,700	200	6,500	4.90E+01	1.01E+02	2.04E+04	9.88E+03
700	200	500	5.00E+01	1.17E+02	2.00E+04	8.56E+03
Sample: 11274.5 Porosity: 0.001 Bulk Density: 2.936						
700	200	500	5.10E+01	1.06E+02	1.96E+04	9.39E+03
1,700	200	1,500	5.04E+01	1.04E+02	1.98E+04	9.64E+03
3,700	200	3,500	5.01E+01	1.01E+02	1.99E+04	9.92E+03
6,700	200	6,500	4.97E+01	9.97E+01	2.01E+04	1.00E+04
700	200	500	5.07E+01	1.08E+02	1.97E+04	9.28E+03
Sample: 11275.5 Porosity: 0.005 Bulk Density: 2.902						
700	200	500	5.16E+01	1.22E+02	1.94E+04	8.22E+03
1,700	200	1,500	5.08E+01	1.11E+02	1.97E+04	9.03E+03
3,700	200	3,500	4.94E+01	1.06E+02	2.02E+04	9.47E+03
6,700	200	6,500	4.89E+01	1.01E+02	2.04E+04	9.95E+03
700	200	500	5.11E+01	1.16E+02	1.96E+04	8.64E+03
Sample: 11276.5 Porosity: 0.020 Bulk Density: 2.849						
700	200	500	5.45E+01	1.29E+02	1.83E+04	7.77E+03
1,700	200	1,500	5.34E+01	1.14E+02	1.87E+04	8.74E+03
3,700	200	3,500	5.13E+01	1.10E+02	1.95E+04	9.10E+03
6,700	200	6,500	5.00E+01	1.04E+02	2.00E+04	9.64E+03
700	200	500	5.44E+01	1.18E+02	1.84E+04	8.46E+03

Measurements by:

PBT, Inc. 303 East Street Golden, Colorado 80403 (303) 279 1647

Job 91003 5/6/91

Table A-1 contd.

Contractor:	Contract: DE-AC22-91BC14655
Ikwuakolam Energy Company, Inc.	Well: Chevron Melby 4-1
2413 Washington Street	NWSW Sec 1 T33N R58E
Denver, Colorado 80205	Brush Lake Field
	Sheridan County, Montana

ROCK PROPERTY MEASUREMENTS

(POROSITY, DENSITY, COMPRESSIONAL AND SHEAR WAVE SLOWNESS AND VELOCITY)

Conf. Press.	Pore Press.	Effect. Press.	Delta tp	Delta ts	Comp. Velocity	Shear Velocity
-----	psi	-----	----	usec/ft	----	ft/sec
Sample: 11277.5 Porosity: 0.022 Bulk Density: 2.758						
700	200	500	4.84E+01	9.46E+01	2.07E+04	1.06E+04
1,700	200	1,500	4.78E+01	9.00E+01	2.09E+04	1.11E+04
3,700	200	3,500	4.75E+01	8.77E+01	2.11E+04	1.14E+04
6,700	200	6,500	4.67E+01	8.52E+01	2.14E+04	1.17E+04
700	200	500	4.86E+01	9.31E+01	2.06E+04	1.07E+04
Sample: 11278.5 Porosity: 0.038 Bulk Density: 2.756						
700	200	500	4.97E+01	9.59E+01	2.01E+04	1.04E+04
1,700	200	1,500	4.95E+01	9.35E+01	2.02E+04	1.07E+04
3,700	200	3,500	4.88E+01	9.08E+01	2.05E+04	1.10E+04
6,700	200	6,500	4.80E+01	8.82E+01	2.08E+04	1.13E+04
700	200	500	4.98E+01	9.51E+01	2.01E+04	1.05E+04
Sample: 11279.5 Porosity: 0.063 Bulk Density: 2.736						
700	200	500	5.28E+01	1.02E+02	1.89E+04	9.80E+03
1,700	200	1,500	5.09E+01	9.73E+01	1.96E+04	1.03E+04
3,700	200	3,500	4.99E+01	9.29E+01	2.00E+04	1.08E+04
6,700	200	6,500	4.89E+01	8.95E+01	2.05E+04	1.12E+04
700	200	500	5.22E+01	1.01E+02	1.92E+04	9.88E+03
Sample: 11280 Porosity: 0.056 Bulk Density: 2.749						
700	200	500	5.08E+01	9.79E+01	1.97E+04	1.02E+04
1,700	200	1,500	5.01E+01	9.50E+01	2.00E+04	1.05E+04
3,700	200	3,500	4.91E+01	9.12E+01	2.04E+04	1.10E+04
6,700	200	6,500	4.81E+01	8.98E+01	2.08E+04	1.11E+04
700	200	500	5.06E+01	9.77E+01	1.98E+04	1.02E+04
Sample: 11281 Porosity: 0.061 Bulk Density: 2.741						
700	200	500	5.14E+01	1.00E+02	1.94E+04	9.97E+03
1,700	200	1,500	5.08E+01	9.74E+01	1.97E+04	1.03E+04
3,700	200	3,500	4.98E+01	9.36E+01	2.01E+04	1.07E+04
6,700	200	6,500	4.87E+01	9.01E+01	2.05E+04	1.11E+04
700	200	500	5.14E+01	1.00E+02	1.95E+04	9.97E+03

Measurements by:

PBT, Inc. 303 East Street Golden, Colorado 80403 (303) 279 1647

Job 91003 5/6/91

2 of 29 of Velocity Data

Table A-1 contd.

Contractor:
Ikwuakolam Energy Company, Inc.
2413 Washington Street
Denver, Colorado 80205

Contract: DE-AC22-91BC14655
Well: Chevron Melby 4-1
NWSW Sec 1 T33N R58E
Brush Lake Field
Sheridan County, Montana

ROCK PROPERTY MEASUREMENTS

(POROSITY, DENSITY, COMPRESSIONAL AND SHEAR WAVE SLOWNESS AND VELOCITY)

Conf. Press.	Pore Press.	Effect. Press.	Delta tp	Delta ts	Comp. Velocity	Shear Velocity
-----	psi	-----	----	usec/ft	-----	ft/sec
Sample: 11282 Porosity: 0.062 Bulk Density: 2.740						
700	200	500	4.99E+01	9.88E+01	2.00E+04	1.01E+04
1,700	200	1,500	4.95E+01	9.54E+01	2.02E+04	1.05E+04
3,700	200	3,500	4.85E+01	9.12E+01	2.06E+04	1.10E+04
6,700	200	6,500	4.76E+01	8.86E+01	2.10E+04	1.13E+04
700	200	500	5.01E+01	9.78E+01	2.00E+04	1.02E+04
Sample: 11283 Porosity: 0.056 Bulk Density: 2.745						
700	200	500	4.99E+01	9.55E+01	2.01E+04	1.05E+04
1,700	200	1,500	4.94E+01	9.27E+01	2.02E+04	1.08E+04
3,700	200	3,500	4.87E+01	9.04E+01	2.05E+04	1.11E+04
6,700	200	6,500	4.77E+01	8.84E+01	2.10E+04	1.13E+04
700	200	500	5.07E+01	9.61E+01	1.97E+04	1.04E+04
Sample: 11284 Porosity: 0.151 Bulk Density: 2.563						
700	200	500	6.18E+01	1.20E+02	1.62E+04	8.34E+03
1,700	200	1,500	6.04E+01	1.14E+02	1.66E+04	8.80E+03
3,700	200	3,500	5.96E+01	1.10E+02	1.68E+04	9.05E+03
6,700	200	6,500	5.78E+01	1.06E+02	1.73E+04	9.42E+03
700	200	500	6.24E+01	1.20E+02	1.60E+04	8.31E+03
Sample: 11285 Porosity: 0.105 Bulk Density: 2.648						
700	200	500	6.00E+01	1.21E+02	1.67E+04	8.28E+03
1,700	200	1,500	5.84E+01	1.12E+02	1.71E+04	8.93E+03
3,700	200	3,500	5.61E+01	1.06E+02	1.78E+04	9.46E+03
6,700	200	6,500	5.41E+01	1.00E+02	1.85E+04	9.98E+03
700	200	500	5.98E+01	1.22E+02	1.67E+04	8.17E+03
Sample: 11286 Porosity: 0.070 Bulk Density: 2.673						
700	200	500	6.43E+01	1.38E+02	1.55E+04	7.25E+03
1,700	200	1,500	6.05E+01	1.22E+02	1.65E+04	8.22E+03
3,700	200	3,500	5.69E+01	1.11E+02	1.76E+04	9.05E+03
6,700	200	6,500	5.40E+01	1.03E+02	1.85E+04	9.70E+03
700	200	500	6.32E+01	1.37E+02	1.58E+04	7.31E+03

Measurements by:

PBT, Inc. 303 East Street Golden, Colorado 80403 (303) 279 1647

Job 91003 5/6/91

3 of 29 of Velocity Data

Table A-1 contd.

Contractor:
Ikwaakolam Energy Company, Inc.
2413 Washington Street
Denver, Colorado 80205

Contract: DE-AC22-91BC14655
Well: Chevron Melby 4-1
NWSW Sec 1 T33N R58E
Brush Lake Field
Sheridan County, Montana

ROCK PROPERTY MEASUREMENTS

(POROSITY, DENSITY, COMPRESSIONAL AND SHEAR WAVE SLOWNESS AND VELOCITY)

Conf. Press.	Pore Press. psi	Effect. Press.	Delta tp usec/ft	Delta ts usec/ft	Comp. Velocity ft/sec	Shear Velocity ft/sec
Sample: 11287 Porosity: 0.131 Bulk Density: 2.590						
700	200	500	6.12E+01	1.17E+02	1.63E+04	8.56E+03
1,700	200	1,500	5.97E+01	1.11E+02	1.68E+04	8.99E+03
3,700	200	3,500	5.81E+01	1.06E+02	1.72E+04	9.41E+03
6,700	200	6,500	5.67E+01	1.02E+02	1.77E+04	9.79E+03
700	200	500	6.13E+01	1.18E+02	1.63E+04	8.50E+03
Sample: 11288 Porosity: 0.122 Bulk Density: 2.605						
700	200	500	5.93E+01	1.12E+02	1.69E+04	8.91E+03
1,700	200	1,500	5.84E+01	1.09E+02	1.71E+04	9.18E+03
3,700	200	3,500	5.70E+01	1.04E+02	1.76E+04	9.60E+03
6,700	200	6,500	5.56E+01	1.00E+02	1.80E+04	9.99E+03
700	200	500	6.01E+01	1.13E+02	1.66E+04	8.86E+03
Sample: 11289 Porosity: 0.191 Bulk Density: 2.465						
700	200	500	7.00E+01	1.33E+02	1.43E+04	7.51E+03
1,700	200	1,500	6.76E+01	1.26E+02	1.48E+04	7.93E+03
3,700	200	3,500	6.52E+01	1.20E+02	1.53E+04	8.31E+03
6,700	200	6,500	6.34E+01	1.17E+02	1.58E+04	8.57E+03
700	200	500	7.02E+01	1.32E+02	1.42E+04	7.56E+03
Sample: 11290 Porosity: 0.133 Bulk Density: 2.566						
700	200	500	8.00E+01	1.68E+02	1.25E+04	5.97E+03
1,700	200	1,500	7.44E+01	1.47E+02	1.34E+04	6.80E+03
3,700	200	3,500	6.82E+01	1.28E+02	1.47E+04	7.82E+03
6,700	200	6,500	6.37E+01	1.19E+02	1.57E+04	8.40E+03
700	200	500	8.07E+01	1.71E+02	1.24E+04	5.86E+03
Sample: 11291 Porosity: 0.075 Bulk Density: 2.666						
700	200	500	6.54E+01	1.39E+02	1.53E+04	7.17E+03
1,700	200	1,500	6.21E+01	1.23E+02	1.61E+04	8.15E+03
3,700	200	3,500	5.79E+01	1.13E+02	1.73E+04	8.88E+03
6,700	200	6,500	5.49E+01	1.04E+02	1.82E+04	9.66E+03
700	200	500	6.45E+01	1.35E+02	1.55E+04	7.39E+03

Measurements by:

PBT, Inc. 303 East Street Golden, Colorado 80403 (303) 279 1647

Job 91003 5/6/91

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Table A-1 contd.

Contractor:	Contract: DE-AC22-91BC14655
Ikwuakolam Energy Company, Inc.	Well: Chevron Melby 4-1
2413 Washington Street	NWSW Sec 1 T33N R58E
Denver, Colorado 80205	Brush Lake Field
	Sheridan County, Montana

ROCK PROPERTY MEASUREMENTS

(POROSITY, DENSITY, COMPRESSIONAL AND SHEAR WAVE SLOWNESS AND VELOCITY)

Conf. Press.	Pore Press.	Effect. Press.	Delta tp ----- usec/ft -----	Delta ts -----	Comp. Velocity ----- ft/sec -----	Shear Velocity -----
----- psi -----	-----	-----				
Sample: 11292 Porosity: 0.082 Bulk Density: 2.629						
700	200	500	6.73E+01	1.42E+02	1.49E+04	7.06E+03
1,700	200	1,500	6.31E+01	1.28E+02	1.58E+04	7.81E+03
3,700	200	3,500	5.90E+01	1.14E+02	1.69E+04	8.75E+03
6,700	200	6,500	5.58E+01	1.06E+02	1.79E+04	9.41E+03
700	200	500	6.63E+01	1.40E+02	1.51E+04	7.12E+03
Sample: 11293 Porosity: 0.160 Bulk Density: 2.524						
700	200	500	7.26E+01	1.42E+02	1.38E+04	7.04E+03
1,700	200	1,500	6.95E+01	1.32E+02	1.44E+04	7.56E+03
3,700	200	3,500	6.60E+01	1.24E+02	1.52E+04	8.07E+03
6,700	200	6,500	6.28E+01	1.17E+02	1.59E+04	8.54E+03
700	200	500	7.29E+01	1.45E+02	1.37E+04	6.88E+03
Sample: 11294 Porosity: 0.126 Bulk Density: 2.586						
700	200	500	6.79E+01	1.32E+02	1.47E+04	7.58E+03
1,700	200	1,500	6.51E+01	1.22E+02	1.54E+04	8.22E+03
3,700	200	3,500	6.13E+01	1.13E+02	1.63E+04	8.81E+03
6,700	200	6,500	5.91E+01	1.08E+02	1.69E+04	9.27E+03
700	200	500	6.85E+01	1.33E+02	1.46E+04	7.50E+03
Sample: 11295 Porosity: 0.085 Bulk Density: 2.633						
700	200	500	6.68E+01	1.55E+02	1.50E+04	6.45E+03
1,700	200	1,500	6.23E+01	1.29E+02	1.61E+04	7.77E+03
3,700	200	3,500	5.69E+01	1.10E+02	1.76E+04	9.09E+03
6,700	200	6,500	5.34E+01	1.02E+02	1.87E+04	9.79E+03
700	200	500	6.53E+01	1.48E+02	1.53E+04	6.74E+03
Sample: 11296 Porosity: 0.011 Bulk Density: 2.756						
700	200	500	5.30E+01	1.15E+02	1.89E+04	8.68E+03
1,700	200	1,500	5.25E+01	1.10E+02	1.91E+04	9.12E+03
3,700	200	3,500	5.19E+01	1.04E+02	1.93E+04	9.57E+03
6,700	200	6,500	5.11E+01	1.02E+02	1.96E+04	9.77E+03
700	200	500	5.29E+01	1.12E+02	1.89E+04	8.96E+03

Measurements by:

PBT, Inc. 303 East Street Golden, Colorado 80403 (303) 279 1647

Job 91003 5/6/91

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Table A-1 contd.

Contractor:	Contract: DE-AC22-91BC14655
Ikwuakolam Energy Company, Inc.	Well: Chevron Melby 4-1
2413 Washington Street	NWSW Sec 1 T33N R58E
Denver, Colorado 80205	Brush Lake Field
	Sheridan County, Montana

ROCK PROPERTY MEASUREMENTS

(POROSITY, DENSITY, COMPRESSIONAL AND SHEAR WAVE SLOWNESS AND VELOCITY)

Conf. Press.	Pore Press.	Effect. Press.	Delta tp ----- usec/ft -----	Delta ts -----	Comp. Velocity ----- ft/sec -----	Shear Velocity -----
----- psi -----	-----	-----	-----	-----	-----	-----
Sample: 11297 Porosity: 0.101 Bulk Density: 2.600						
700	200	500	5.51E+01	1.09E+02	1.82E+04	9.20E+03
1,700	200	1,500	5.41E+01	1.05E+02	1.85E+04	9.50E+03
3,700	200	3,500	5.28E+01	9.98E+01	1.89E+04	1.00E+04
6,700	200	6,500	5.15E+01	9.66E+01	1.94E+04	1.03E+04
700	200	500	5.53E+01	1.08E+02	1.81E+04	9.24E+03
Sample: 11298 Porosity: 0.027 Bulk Density: 2.745						
700	200	500	4.81E+01	9.65E+01	2.08E+04	1.04E+04
1,700	200	1,500	4.78E+01	9.19E+01	2.09E+04	1.09E+04
3,700	200	3,500	4.75E+01	8.99E+01	2.10E+04	1.11E+04
6,700	200	6,500	4.69E+01	8.86E+01	2.13E+04	1.13E+04
700	200	500	4.84E+01	9.57E+01	2.06E+04	1.05E+04
Sample: 11299 Porosity: 0.008 Bulk Density: 2.736						
700	200	500	5.14E+01	9.99E+01	1.95E+04	1.00E+04
1,700	200	1,500	5.08E+01	9.41E+01	1.97E+04	1.06E+04
3,700	200	3,500	4.98E+01	9.25E+01	2.01E+04	1.08E+04
6,700	200	6,500	4.92E+01	9.12E+01	2.03E+04	1.10E+04
700	200	500	5.06E+01	9.67E+01	1.98E+04	1.03E+04
Sample: 11300 Porosity: 0.012 Bulk Density: 2.760						
700	200	500	5.01E+01	9.89E+01	1.99E+04	1.01E+04
1,700	200	1,500	4.96E+01	9.40E+01	2.02E+04	1.06E+04
3,700	200	3,500	4.90E+01	9.15E+01	2.04E+04	1.09E+04
6,700	200	6,500	4.83E+01	8.90E+01	2.07E+04	1.12E+04
700	200	500	5.00E+01	9.93E+01	2.00E+04	1.01E+04
Sample: 11301 Porosity: 0.035 Bulk Density: 2.657						
700	200	500	5.32E+01	1.06E+02	1.88E+04	9.40E+03
1,700	200	1,500	5.30E+01	1.02E+02	1.89E+04	9.77E+03
3,700	200	3,500	5.14E+01	9.98E+01	1.94E+04	1.00E+04
6,700	200	6,500	5.09E+01	9.78E+01	1.96E+04	1.02E+04
700	200	500	5.31E+01	1.06E+02	1.88E+04	9.46E+03

Measurements by:

PBT, Inc. 303 East Street Golden, Colorado 80403 (303) 279 1647

Job 91003 5/6/91

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Table A-1 contd.

Contractor:	Contract: DE-AC22-91BC14655
Ikwuakolam Energy Company, Inc.	Well: Chevron Melby 4-1
2413 Washington Street	NWSW Sec 1 T33N R58E
Denver, Colorado 80205	Brush Lake Field
	Sheridan County, Montana

ROCK PROPERTY MEASUREMENTS

(POROSITY, DENSITY, COMPRESSIONAL AND SHEAR WAVE SLOWNESS AND VELOCITY)

Conf. Press.	Pore Press.	Effect. Press.	Delta tp	Delta ts	Comp. Velocity	Shear Velocity
-----	psi	-----	---- usec/ft	----	----- ft/sec	-----
Sample: 11302 Porosity: 0.105 Bulk Density: 2.598						
700	200	500	5.63E+01	1.18E+02	1.78E+04	8.51E+03
1,700	200	1,500	5.51E+01	1.09E+02	1.81E+04	9.18E+03
3,700	200	3,500	5.41E+01	1.03E+02	1.85E+04	9.70E+03
6,700	200	6,500	5.31E+01	1.00E+02	1.88E+04	9.99E+03
700	200	500	5.66E+01	1.17E+02	1.77E+04	8.52E+03
Sample: 11303 Porosity: 0.060 Bulk Density: 2.684						
700	200	500	5.84E+01	1.21E+02	1.71E+04	8.25E+03
1,700	200	1,500	5.83E+01	1.15E+02	1.71E+04	8.70E+03
3,700	200	3,500	5.65E+01	1.08E+02	1.77E+04	9.28E+03
6,700	200	6,500	5.34E+01	1.02E+02	1.87E+04	9.76E+03
700	200	500	5.91E+01	1.21E+02	1.69E+04	8.29E+03
Sample: 11304 Porosity: 0.023 Bulk Density: 2.697						
700	200	500	5.16E+01	1.03E+02	1.94E+04	9.75E+03
1,700	200	1,500	5.12E+01	1.00E+02	1.95E+04	9.97E+03
3,700	200	3,500	5.08E+01	9.82E+01	1.97E+04	1.02E+04
6,700	200	6,500	5.05E+01	9.71E+01	1.98E+04	1.03E+04
700	200	500	5.18E+01	1.03E+02	1.93E+04	9.74E+03
Sample: 11305 Porosity: 0.016 Bulk Density: 2.693						
700	200	500	5.17E+01	1.06E+02	1.94E+04	9.47E+03
1,700	200	1,500	5.15E+01	1.02E+02	1.94E+04	9.78E+03
3,700	200	3,500	5.09E+01	1.00E+02	1.97E+04	1.00E+04
6,700	200	6,500	4.95E+01	9.75E+01	2.02E+04	1.03E+04
700	200	500	5.23E+01	1.06E+02	1.91E+04	9.40E+03
Sample: 11306 Porosity: 0.011 Bulk Density: 2.704						
700	200	500	5.08E+01	1.04E+02	1.97E+04	9.65E+03
1,700	200	1,500	5.05E+01	9.98E+01	1.98E+04	1.00E+04
3,700	200	3,500	5.01E+01	9.76E+01	2.00E+04	1.03E+04
6,700	200	6,500	4.96E+01	9.57E+01	2.02E+04	1.05E+04
700	200	500	5.28E+01	1.05E+02	1.89E+04	9.48E+03

Measurements by:
PBT, Inc. 303 East Street Golden, Colorado 80403 (303) 279 1647

Job 91003 5/6/91

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Table A-1 contd.

Contractor:	Contract: DE-AC22-91BC14655
Ikwaakolam Energy Company, Inc.	Well: Chevron Melby 4-1
2413 Washington Street	NWSW Sec 1 T33N R58E
Denver, Colorado 80205	Brush Lake Field
	Sheridan County, Montana

ROCK PROPERTY MEASUREMENTS

(POROSITY, DENSITY, COMPRESSIONAL AND SHEAR WAVE SLOWNESS AND VELOCITY)

Conf. Press.	Pore Press. psi	Effect. Press.	Delta tp usec/ft	Delta ts	Comp. Velocity ft/sec	Shear Velocity
Sample: 11307 Porosity: 0.011 Bulk Density: 2.693						
700	200	500	5.00E+01	1.00E+02	2.00E+04	9.96E+03
1,700	200	1,500	4.95E+01	9.74E+01	2.02E+04	1.03E+04
3,700	200	3,500	4.92E+01	9.57E+01	2.03E+04	1.04E+04
6,700	200	6,500	4.89E+01	9.40E+01	2.05E+04	1.06E+04
700	200	500	5.08E+01	9.97E+01	1.97E+04	1.00E+04
Sample: 11308 Porosity: 0.014 Bulk Density: 2.693						
700	200	500	4.96E+01	1.00E+02	2.02E+04	1.00E+04
1,700	200	1,500	4.93E+01	9.78E+01	2.03E+04	1.02E+04
3,700	200	3,500	4.85E+01	9.51E+01	2.06E+04	1.05E+04
6,700	200	6,500	4.81E+01	9.32E+01	2.08E+04	1.07E+04
700	200	500	4.96E+01	1.02E+02	2.02E+04	9.79E+03
Sample: 11309 Porosity: 0.016 Bulk Density: 2.698						
700	200	500	5.02E+01	1.06E+02	1.99E+04	9.47E+03
1,700	200	1,500	5.00E+01	1.01E+02	2.00E+04	9.88E+03
3,700	200	3,500	4.94E+01	9.82E+01	2.02E+04	1.02E+04
6,700	200	6,500	4.89E+01	9.53E+01	2.04E+04	1.05E+04
700	200	500	5.13E+01	1.05E+02	1.95E+04	9.50E+03
Sample: 11310 Porosity: 0.016 Bulk Density: 2.693						
700	200	500	5.11E+01	1.10E+02	1.96E+04	9.09E+03
1,700	200	1,500	5.05E+01	1.03E+02	1.98E+04	9.68E+03
3,700	200	3,500	4.96E+01	9.89E+01	2.02E+04	1.01E+04
6,700	200	6,500	4.91E+01	9.58E+01	2.04E+04	1.04E+04
700	200	500	5.12E+01	1.11E+02	1.95E+04	9.04E+03
Sample: 11311 Porosity: 0.028 Bulk Density: 2.668						
700	200	500	5.14E+01	1.07E+02	1.95E+04	9.38E+03
1,700	200	1,500	5.13E+01	1.02E+02	1.95E+04	9.77E+03
3,700	200	3,500	5.09E+01	9.97E+01	1.97E+04	1.00E+04
6,700	200	6,500	4.97E+01	9.72E+01	2.01E+04	1.03E+04
700	200	500	5.15E+01	1.08E+02	1.94E+04	9.25E+03

Measurements by:

PBT, Inc. 303 East Street Golden, Colorado 80403 (303) 279 1647

Job 91003 5/6/91

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Table A-1 contd.

Contractor:	Contract: DE-AC22-91BC14655
Ikwaakolam Energy Company, Inc.	Well: Chevron Melby 4-1
2413 Washington Street	NWSW Sec 1 T33N R58E
Denver, Colorado 80205	Brush Lake Field
	Sheridan County, Montana

ROCK PROPERTY MEASUREMENTS

(POROSITY, DENSITY, COMPRESSIONAL AND SHEAR WAVE SLOWNESS AND VELOCITY)

Conf. Press.	Pore Press.	Effect. Press.	Delta tp	Delta ts	Comp. Velocity	Shear Velocity
-----	psi	-----	---- usec/ft ----	----	----- ft/sec -----	-----
Sample: 11312 Porosity: 0.028 Bulk Density: 2.681						
700	200	500	5.07E+01	1.05E+02	1.97E+04	9.50E+03
1,700	200	1,500	5.05E+01	1.01E+02	1.98E+04	9.89E+03
3,700	200	3,500	4.97E+01	9.83E+01	2.01E+04	1.02E+04
6,700	200	6,500	4.93E+01	9.51E+01	2.03E+04	1.05E+04
700	200	500	5.09E+01	1.06E+02	1.96E+04	9.44E+03
Sample: 11313 Porosity: 0.048 Bulk Density: 2.697						
700	200	500	5.57E+01	1.17E+02	1.80E+04	8.58E+03
1,700	200	1,500	5.42E+01	1.12E+02	1.84E+04	8.96E+03
3,700	200	3,500	5.31E+01	1.04E+02	1.88E+04	9.59E+03
6,700	200	6,500	5.16E+01	9.90E+01	1.94E+04	1.01E+04
700	200	500	5.54E+01	1.19E+02	1.81E+04	8.43E+03
Sample: 11314 Porosity: 0.028 Bulk Density: 2.680						
700	200	500	5.36E+01	1.12E+02	1.87E+04	8.92E+03
1,700	200	1,500	5.28E+01	1.08E+02	1.89E+04	9.29E+03
3,700	200	3,500	5.20E+01	1.03E+02	1.92E+04	9.66E+03
6,700	200	6,500	5.09E+01	9.98E+01	1.96E+04	1.00E+04
700	200	500	5.36E+01	1.12E+02	1.87E+04	8.96E+03
Sample: 11315 Porosity: 0.009 Bulk Density: 2.714						
700	200	500	5.01E+01	1.02E+02	2.00E+04	9.83E+03
1,700	200	1,500	4.97E+01	1.00E+02	2.01E+04	9.95E+03
3,700	200	3,500	4.91E+01	9.77E+01	2.04E+04	1.02E+04
6,700	200	6,500	4.85E+01	9.49E+01	2.06E+04	1.05E+04
700	200	500	5.16E+01	1.03E+02	1.94E+04	9.73E+03
Sample: 11316 Porosity: 0.036 Bulk Density: 2.687						
700	200	500	5.53E+01	1.16E+02	1.81E+04	8.63E+03
1,700	200	1,500	5.45E+01	1.10E+02	1.84E+04	9.06E+03
3,700	200	3,500	5.27E+01	1.04E+02	1.90E+04	9.61E+03
6,700	200	6,500	5.17E+01	9.84E+01	1.93E+04	1.02E+04
700	200	500	5.59E+01	1.15E+02	1.79E+04	8.68E+03

Measurements by:

PBT, Inc. 303 East Street Golden, Colorado 80403 (303) 279 1647

Job 91003 5/6/91

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Table A-1 contd.

Contractor:	Contract: DE-AC22-91BC14655
Ikwuakolam Energy Company, Inc.	Well: Chevron Melby 4-1
2413 Washington Street	NWSW Sec 1 T33N R58E
Denver, Colorado 80205	Brush Lake Field
	Sheridan County, Montana

ROCK PROPERTY MEASUREMENTS

(POROSITY, DENSITY, COMPRESSIONAL AND SHEAR WAVE SLOWNESS AND VELOCITY)

Conf. Press.	Pore Press. psi	Effect. Press.	Delta tp usec/ft	Delta ts usec/ft	Comp. Velocity ft/sec	Shear Velocity ft/sec
Sample: 11317 Porosity: 0.030 Bulk Density: 2.699						
700	200	500	5.48E+01	1.19E+02	1.83E+04	8.38E+03
1,700	200	1,500	5.34E+01	1.11E+02	1.87E+04	8.99E+03
3,700	200	3,500	5.24E+01	1.04E+02	1.91E+04	9.63E+03
6,700	200	6,500	5.15E+01	9.98E+01	1.94E+04	1.00E+04
700	200	500	5.58E+01	1.15E+02	1.79E+04	8.73E+03
Sample: 11318 Porosity: 0.026 Bulk Density: 2.684						
700	200	500	5.13E+01	1.06E+02	1.95E+04	9.46E+03
1,700	200	1,500	5.11E+01	1.03E+02	1.96E+04	9.70E+03
3,700	200	3,500	5.06E+01	9.90E+01	1.98E+04	1.01E+04
6,700	200	6,500	5.00E+01	9.75E+01	2.00E+04	1.03E+04
700	200	500	5.23E+01	1.05E+02	1.91E+04	9.56E+03
Sample: 11319 Porosity: 0.024 Bulk Density: 2.676						
700	200	500	5.13E+01	1.03E+02	1.95E+04	9.69E+03
1,700	200	1,500	5.10E+01	1.01E+02	1.96E+04	9.93E+03
3,700	200	3,500	5.05E+01	9.82E+01	1.98E+04	1.02E+04
6,700	200	6,500	4.99E+01	9.61E+01	2.00E+04	1.04E+04
700	200	500	5.17E+01	1.03E+02	1.93E+04	9.70E+03
Sample: 11320 Porosity: 0.036 Bulk Density: 2.649						
700	200	500	5.60E+01	1.17E+02	1.78E+04	8.57E+03
1,700	200	1,500	5.42E+01	1.07E+02	1.85E+04	9.39E+03
3,700	200	3,500	5.35E+01	1.01E+02	1.87E+04	9.92E+03
6,700	200	6,500	5.24E+01	9.63E+01	1.91E+04	1.04E+04
700	200	500	5.60E+01	1.14E+02	1.78E+04	8.76E+03
Sample: 11321 Porosity: 0.024 Bulk Density: 2.678						
700	200	500	5.19E+01	1.11E+02	1.93E+04	9.04E+03
1,700	200	1,500	5.13E+01	1.04E+02	1.95E+04	9.59E+03
3,700	200	3,500	5.06E+01	9.95E+01	1.98E+04	1.00E+04
6,700	200	6,500	4.97E+01	9.61E+01	2.01E+04	1.04E+04
700	200	500	5.18E+01	1.10E+02	1.93E+04	9.07E+03

Measurements by:

PBT, Inc. 303 East Street Golden, Colorado 80403 (303) 279 1647

Job 91003 5/6/91

Table A-1 contd.

Contractor:	Contract: DE-AC22-91BC14655
Ikwaakolam Energy Company, Inc.	Well: Chevron Melby 4-1
2413 Washington Street	NWSW Sec 1 T33N R58E
Denver, Colorado 80205	Brush Lake Field
	Sheridan County, Montana

ROCK PROPERTY MEASUREMENTS

(POROSITY, DENSITY, COMPRESSIONAL AND SHEAR WAVE SLOWNESS AND VELOCITY)

Conf. Press.	Pore Press. ----- psi -----	Effect. Press.	Delta tp ----- usec/ft -----	Delta ts -----	Comp. Velocity ----- ft/sec -----	Shear Velocity
Sample: 11322 Porosity: 0.022 Bulk Density: 2.677						
700	200	500	4.96E+01	1.03E+02	2.02E+04	9.70E+03
1,700	200	1,500	4.90E+01	9.78E+01	2.04E+04	1.02E+04
3,700	200	3,500	4.88E+01	9.54E+01	2.05E+04	1.05E+04
6,700	200	6,500	4.82E+01	9.39E+01	2.07E+04	1.07E+04
700	200	500	4.97E+01	1.02E+02	2.01E+04	9.81E+03
Sample: 11323 Porosity: 0.020 Bulk Density: 2.678						
700	200	500	5.09E+01	1.10E+02	1.96E+04	9.11E+03
1,700	200	1,500	5.04E+01	1.04E+02	1.98E+04	9.61E+03
3,700	200	3,500	4.98E+01	9.92E+01	2.01E+04	1.01E+04
6,700	200	6,500	4.94E+01	9.63E+01	2.03E+04	1.04E+04
700	200	500	5.06E+01	1.10E+02	1.98E+04	9.07E+03
Sample: 11324 Porosity: 0.023 Bulk Density: 2.675						
700	200	500	5.22E+01	1.12E+02	1.92E+04	8.93E+03
1,700	200	1,500	5.14E+01	1.06E+02	1.95E+04	9.44E+03
3,700	200	3,500	5.07E+01	1.01E+02	1.97E+04	9.90E+03
6,700	200	6,500	4.96E+01	9.79E+01	2.01E+04	1.02E+04
700	200	500	5.23E+01	1.10E+02	1.91E+04	9.07E+03
Sample: 11325 Porosity: 0.026 Bulk Density: 2.667						
700	200	500	5.10E+01	1.07E+02	1.96E+04	9.36E+03
1,700	200	1,500	5.04E+01	1.04E+02	1.99E+04	9.64E+03
3,700	200	3,500	5.08E+01	1.01E+02	1.97E+04	9.95E+03
6,700	200	6,500	5.04E+01	9.80E+01	1.99E+04	1.02E+04
700	200	500	5.14E+01	1.09E+02	1.94E+04	9.21E+03
Sample: 11326 Porosity: 0.015 Bulk Density: 2.689						
700	200	500	5.01E+01	1.03E+02	2.00E+04	9.69E+03
1,700	200	1,500	4.96E+01	9.91E+01	2.02E+04	1.01E+04
3,700	200	3,500	4.92E+01	9.71E+01	2.03E+04	1.03E+04
6,700	200	6,500	4.86E+01	9.51E+01	2.06E+04	1.05E+04
700	200	500	5.10E+01	1.03E+02	1.96E+04	9.66E+03

Measurements by:

PBT, Inc. 303 East Street Golden, Colorado 80403 (303) 279 1647

Job 91003 5/6/91

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Table A-1 contd.

Contractor:	Contract: DE-AC22-91BC14655
Ikwaakolam Energy Company, Inc.	Well: Chevron Melby 4-1
2413 Washington Street	NWSW Sec 1 T33N R58E
Denver, Colorado 80205	Brush Lake Field
	Sheridan County, Montana

ROCK PROPERTY MEASUREMENTS

(POROSITY, DENSITY, COMPRESSIONAL AND SHEAR WAVE SLOWNESS AND VELOCITY)

Conf. Press.	Pore Press. psi	Effect. Press.	Delta tp usec/ft	Delta ts	Comp. Velocity ft/sec	Shear Velocity
Sample: 11327 Porosity: 0.052 Bulk Density: 2.632						
700	200	500	5.28E+01	1.14E+02	1.90E+04	8.79E+03
1,700	200	1,500	5.21E+01	1.06E+02	1.92E+04	9.45E+03
3,700	200	3,500	5.12E+01	1.02E+02	1.95E+04	9.84E+03
6,700	200	6,500	5.04E+01	9.98E+01	1.99E+04	1.00E+04
700	200	500	5.30E+01	1.10E+02	1.89E+04	9.10E+03
Sample: 11328 Porosity: 0.032 Bulk Density: 2.667						
700	200	500	5.16E+01	1.09E+02	1.94E+04	9.15E+03
1,700	200	1,500	5.11E+01	1.06E+02	1.96E+04	9.48E+03
3,700	200	3,500	5.06E+01	1.01E+02	1.98E+04	9.88E+03
6,700	200	6,500	5.03E+01	9.83E+01	1.99E+04	1.02E+04
700	200	500	5.37E+01	1.09E+02	1.86E+04	9.20E+03
Sample: 11329 Porosity: 0.056 Bulk Density: 2.632						
700	200	500	5.38E+01	1.11E+02	1.86E+04	9.02E+03
1,700	200	1,500	5.30E+01	1.07E+02	1.89E+04	9.34E+03
3,700	200	3,500	5.21E+01	1.03E+02	1.92E+04	9.69E+03
6,700	200	6,500	5.13E+01	1.01E+02	1.95E+04	9.94E+03
700	200	500	5.38E+01	1.11E+02	1.86E+04	9.03E+03
Sample: 11330 Porosity: 0.016 Bulk Density: 2.709						
700	200	500	5.28E+01	1.11E+02	1.89E+04	9.01E+03
1,700	200	1,500	5.25E+01	1.07E+02	1.90E+04	9.35E+03
3,700	200	3,500	5.15E+01	1.01E+02	1.94E+04	9.85E+03
6,700	200	6,500	5.00E+01	9.85E+01	2.00E+04	1.02E+04
700	200	500	5.47E+01	1.10E+02	1.83E+04	9.08E+03
Sample: 11331 Porosity: 0.018 Bulk Density: 2.672						
700	200	500	5.12E+01	1.07E+02	1.95E+04	9.33E+03
1,700	200	1,500	5.06E+01	1.03E+02	1.98E+04	9.68E+03
3,700	200	3,500	5.00E+01	9.94E+01	2.00E+04	1.01E+04
6,700	200	6,500	4.97E+01	9.69E+01	2.01E+04	1.03E+04
700	200	500	5.14E+01	1.08E+02	1.95E+04	9.23E+03

Measurements by:

PBT, Inc. 303 East Street Golden, Colorado 80403 (303) 279 1647

Job 91003 5/6/91

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Table A-1 contd.

Contractor:	Contract: DE-AC22-91BC14655
Ikwuakolam Energy Company, Inc.	Well: Chevron Melby 4-1
2413 Washington Street	NWSW Sec 1 T33N R58E
Denver, Colorado 80205	Brush Lake Field
	Sheridan County, Montana

ROCK PROPERTY MEASUREMENTS

(POROSITY, DENSITY, COMPRESSIONAL AND SHEAR WAVE SLOWNESS AND VELOCITY)

Conf. Press.	Pore Press.	Effect. Press.	Delta tp ----- usec/ft	Delta ts ----- ft/sec	Comp. Velocity	Shear Velocity
----- psi	----- psi	----- psi	----- usec/ft	----- ft/sec	----- ft/sec	----- ft/sec
Sample: 11332 Porosity: 0.055 Bulk Density: 2.664						
700	200	500	5.89E+01	1.19E+02	1.70E+04	8.38E+03
1,700	200	1,500	5.78E+01	1.12E+02	1.73E+04	8.91E+03
3,700	200	3,500	5.40E+01	1.06E+02	1.85E+04	9.45E+03
6,700	200	6,500	5.24E+01	1.01E+02	1.91E+04	9.90E+03
700	200	500	5.75E+01	1.18E+02	1.74E+04	8.48E+03
Sample: 11333 Porosity: 0.016 Bulk Density: 2.703						
700	200	500	5.17E+01	1.07E+02	1.94E+04	9.31E+03
1,700	200	1,500	5.14E+01	1.02E+02	1.95E+04	9.76E+03
3,700	200	3,500	5.05E+01	9.87E+01	1.98E+04	1.01E+04
6,700	200	6,500	4.94E+01	9.63E+01	2.03E+04	1.04E+04
700	200	500	5.31E+01	1.06E+02	1.88E+04	9.40E+03
Sample: 11334 Porosity: 0.066 Bulk Density: 2.655						
700	200	500	5.68E+01	1.17E+02	1.76E+04	8.56E+03
1,700	200	1,500	5.58E+01	1.10E+02	1.79E+04	9.07E+03
3,700	200	3,500	5.36E+01	1.04E+02	1.87E+04	9.63E+03
6,700	200	6,500	5.24E+01	9.89E+01	1.91E+04	1.01E+04
700	200	500	5.66E+01	1.18E+02	1.77E+04	8.49E+03
Sample: 11335 Porosity: 0.056 Bulk Density: 2.694						
700	200	500	5.74E+01	1.21E+02	1.74E+04	8.24E+03
1,700	200	1,500	5.53E+01	1.11E+02	1.81E+04	9.00E+03
3,700	200	3,500	5.41E+01	1.03E+02	1.85E+04	9.72E+03
6,700	200	6,500	5.25E+01	9.76E+01	1.90E+04	1.03E+04
700	200	500	5.86E+01	1.21E+02	1.71E+04	8.24E+03
Sample: 11336 Porosity: 0.036 Bulk Density: 2.706						
700	200	500	5.65E+01	1.18E+02	1.77E+04	8.44E+03
1,700	200	1,500	5.60E+01	1.12E+02	1.78E+04	8.90E+03
3,700	200	3,500	5.41E+01	1.06E+02	1.85E+04	9.40E+03
6,700	200	6,500	5.30E+01	1.01E+02	1.89E+04	9.93E+03
700	200	500	5.69E+01	1.18E+02	1.76E+04	8.50E+03

Measurements by:

PBT, Inc. 303 East Street Golden, Colorado 80403 (303) 279 1647

Job 91003 5/6/91

Table A-1 contd.

Contractor:	Contract: DE-AC22-91BC14655
Ikwuakolam Energy Company, Inc.	Well: Chevron Melby 4-1
2413 Washington Street	NWSW Sec 1 T33N R58E
Denver, Colorado 80205	Brush Lake Field
	Sheridan County, Montana

ROCK PROPERTY MEASUREMENTS

(POROSITY, DENSITY, COMPRESSIONAL AND SHEAR WAVE SLOWNESS AND VELOCITY)

Conf. Press.	Pore Press. psi	Effect. Press.	Delta tp usec/ft	Delta ts	Comp. Velocity ft/sec	Shear Velocity
Sample: 11337 Porosity: 0.142 Bulk Density: 2.543						
700	200	500	6.62E+01	1.31E+02	1.51E+04	7.66E+03
1,700	200	1,500	6.33E+01	1.21E+02	1.58E+04	8.29E+03
3,700	200	3,500	6.00E+01	1.12E+02	1.67E+04	8.90E+03
6,700	200	6,500	5.72E+01	1.07E+02	1.75E+04	9.34E+03
700	200	500	6.65E+01	1.30E+02	1.50E+04	7.70E+03
Sample: 11338 Porosity: 0.060 Bulk Density: 2.652						
700	200	500	5.90E+01	1.22E+02	1.70E+04	8.18E+03
1,700	200	1,500	5.71E+01	1.16E+02	1.75E+04	8.62E+03
3,700	200	3,500	5.53E+01	1.09E+02	1.81E+04	9.16E+03
6,700	200	6,500	5.35E+01	1.02E+02	1.87E+04	9.77E+03
700	200	500	5.85E+01	1.21E+02	1.71E+04	8.25E+03
Sample: 11339 Porosity: 0.023 Bulk Density: 2.689						
700	200	500	5.27E+01	1.10E+02	1.90E+04	9.13E+03
1,700	200	1,500	5.19E+01	1.02E+02	1.93E+04	9.78E+03
3,700	200	3,500	5.12E+01	1.01E+02	1.95E+04	9.88E+03
6,700	200	6,500	5.06E+01	9.90E+01	1.98E+04	1.01E+04
700	200	500	5.28E+01	1.08E+02	1.89E+04	9.25E+03
Sample: 11340 Porosity: 0.057 Bulk Density: 2.696						
700	200	500	5.48E+01	1.16E+02	1.83E+04	8.61E+03
1,700	200	1,500	5.34E+01	1.06E+02	1.87E+04	9.40E+03
3,700	200	3,500	5.17E+01	9.91E+01	1.93E+04	1.01E+04
6,700	200	6,500	5.03E+01	9.49E+01	1.99E+04	1.05E+04
700	200	500	5.49E+01	1.13E+02	1.82E+04	8.85E+03
Sample: 11341 Porosity: 0.061 Bulk Density: 2.681						
700	200	500	5.68E+01	1.19E+02	1.76E+04	8.39E+03
1,700	200	1,500	5.50E+01	1.10E+02	1.82E+04	9.08E+03
3,700	200	3,500	5.26E+01	1.03E+02	1.90E+04	9.67E+03
6,700	200	6,500	5.15E+01	9.81E+01	1.94E+04	1.02E+04
700	200	500	5.62E+01	1.19E+02	1.78E+04	8.42E+03

Measurements by:

PBT, Inc. 303 East Street Golden, Colorado 80403 (303) 279 1647

Job 91003 5/6/91

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Table A-1 contd.

Contractor:	Contract: DE-AC22-91BC14655
Ikwuakolam Energy Company, Inc.	Well: Chevron Melby 4-1
2413 Washington Street	NWSW Sec 1 T33N R58E
Denver, Colorado 80205	Brush Lake Field
	Sheridan County, Montana

ROCK PROPERTY MEASUREMENTS

(POROSITY, DENSITY, COMPRESSIONAL AND SHEAR WAVE SLOWNESS AND VELOCITY)

Conf. Press.	Pore Press. psi	Effect. Press.	Delta tp ---- usec/ft	Delta ts ----	Comp. Velocity ----- ft/sec	Shear Velocity -----
Sample: 11342 Porosity: 0.085 Bulk Density: 2.655						
700	200	500	5.72E+01	1.14E+02	1.75E+04	8.78E+03
1,700	200	1,500	5.53E+01	1.06E+02	1.81E+04	9.47E+03
3,700	200	3,500	5.21E+01	1.01E+02	1.92E+04	9.94E+03
6,700	200	6,500	5.09E+01	9.67E+01	1.97E+04	1.03E+04
700	200	500	5.53E+01	1.15E+02	1.81E+04	8.72E+03
Sample: 11343 Porosity: 0.034 Bulk Density: 2.713						
700	200	500	5.41E+01	1.23E+02	1.85E+04	8.10E+03
1,700	200	1,500	5.37E+01	1.11E+02	1.86E+04	8.97E+03
3,700	200	3,500	5.23E+01	1.04E+02	1.91E+04	9.63E+03
6,700	200	6,500	4.96E+01	9.73E+01	2.02E+04	1.03E+04
700	200	500	5.53E+01	1.20E+02	1.79E+04	8.32E+03
Sample: 11344 Porosity: 0.022 Bulk Density: 2.738						
700	200	500	5.13E+01	1.09E+02	1.95E+04	9.15E+03
1,700	200	1,500	5.05E+01	1.02E+02	1.98E+04	9.80E+03
3,700	200	3,500	4.95E+01	9.74E+01	2.02E+04	1.03E+04
6,700	200	6,500	4.83E+01	9.38E+01	2.07E+04	1.07E+04
700	200	500	5.35E+01	1.08E+02	1.87E+04	9.26E+03
Sample: 11345 Porosity: 0.029 Bulk Density: 2.729						
700	200	500	5.21E+01	1.14E+02	1.92E+04	8.75E+03
1,700	200	1,500	5.15E+01	1.04E+02	1.94E+04	9.58E+03
3,700	200	3,500	5.02E+01	9.86E+01	1.99E+04	1.01E+04
6,700	200	6,500	4.90E+01	9.47E+01	2.04E+04	1.06E+04
700	200	500	5.20E+01	1.12E+02	1.92E+04	8.89E+03
Sample: 11346 Porosity: 0.050 Bulk Density: 2.703						
700	200	500	5.46E+01	1.20E+02	1.83E+04	8.35E+03
1,700	200	1,500	5.30E+01	1.12E+02	1.89E+04	8.94E+03
3,700	200	3,500	5.13E+01	1.02E+02	1.95E+04	9.85E+03
6,700	200	6,500	4.98E+01	9.48E+01	2.01E+04	1.05E+04
700	200	500	5.41E+01	1.20E+02	1.85E+04	8.36E+03

Measurements by:

PBT, Inc. 303 East Street Golden, Colorado 80403 (303) 279 1647

Job 91003 5/6/91

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Table A-1 contd.

Contractor:	Contract: DE-AC22-91BC14655
Ikwuakolam Energy Company, Inc.	Well: Chevron Melby 4-1
2413 Washington Street	NWSW Sec 1 T33N R58E
Denver, Colorado 80205	Brush Lake Field
	Sheridan County, Montana

ROCK PROPERTY MEASUREMENTS

(POROSITY, DENSITY, COMPRESSIONAL AND SHEAR WAVE SLOWNESS AND VELOCITY)

Conf. Press.	Pore Press.	Effect. Press.	Delta tp ----- usec/ft	Delta ts -----	Comp. Velocity ----- ft/sec	Shear Velocity -----
Sample: 11347 Porosity: 0.031 Bulk Density: 2.709						
700	200	500	5.36E+01	1.17E+02	1.86E+04	8.53E+03
1,700	200	1,500	5.27E+01	1.09E+02	1.90E+04	9.18E+03
3,700	200	3,500	5.10E+01	1.02E+02	1.96E+04	9.80E+03
6,700	200	6,500	5.01E+01	9.63E+01	2.00E+04	1.04E+04
700	200	500	5.33E+01	1.15E+02	1.87E+04	8.66E+03
Sample: 11348 Porosity: 0.040 Bulk Density: 2.706						
700	200	500	5.67E+01	1.34E+02	1.76E+04	7.48E+03
1,700	200	1,500	5.38E+01	1.15E+02	1.86E+04	8.67E+03
3,700	200	3,500	5.18E+01	1.03E+02	1.93E+04	9.70E+03
6,700	200	6,500	5.02E+01	9.75E+01	1.99E+04	1.03E+04
700	200	500	5.55E+01	1.28E+02	1.80E+04	7.84E+03
Sample: 11349 Porosity: 0.029 Bulk Density: 2.719						
700	200	500	5.26E+01	1.09E+02	1.90E+04	9.21E+03
1,700	200	1,500	5.17E+01	1.04E+02	1.93E+04	9.65E+03
3,700	200	3,500	5.08E+01	9.79E+01	1.97E+04	1.02E+04
6,700	200	6,500	4.96E+01	9.42E+01	2.01E+04	1.06E+04
700	200	500	5.44E+01	1.08E+02	1.84E+04	9.26E+03
Sample: 11350 Porosity: 0.014 Bulk Density: 2.730						
700	200	500	5.22E+01	1.11E+02	1.91E+04	9.02E+03
1,700	200	1,500	5.13E+01	1.06E+02	1.95E+04	9.43E+03
3,700	200	3,500	5.04E+01	9.96E+01	1.98E+04	1.00E+04
6,700	200	6,500	4.89E+01	9.66E+01	2.04E+04	1.03E+04
700	200	500	5.56E+01	1.14E+02	1.80E+04	8.76E+03
Sample: 11351 Porosity: 0.011 Bulk Density: 2.588						
700	200	500	6.58E+01	1.27E+02	1.52E+04	7.85E+03
1,700	200	1,500	6.52E+01	1.23E+02	1.53E+04	8.15E+03
3,700	200	3,500	6.40E+01	1.19E+02	1.56E+04	8.40E+03
6,700	200	6,500	6.24E+01	1.14E+02	1.60E+04	8.78E+03
700	200	500	6.64E+01	1.28E+02	1.51E+04	7.81E+03

Measurements by:

PBT, Inc. 303 East Street Golden, Colorado 80403 (303) 279 1647

Job 91003 5/6/91

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Table A-1 contd.

Contractor:	Contract: DE-AC22-91BC14655
Ikwuakolam Energy Company, Inc.	Well: Chevron Melby 4-1
2413 Washington Street	NWSW Sec 1 T33N R58E
Denver, Colorado 80205	Brush Lake Field
	Sheridan County, Montana

ROCK PROPERTY MEASUREMENTS

(POROSITY, DENSITY, COMPRESSIONAL AND SHEAR WAVE SLOWNESS AND VELOCITY)

Conf. Press.	Pore Press.	Effect. Press.	Delta tp ----- usec/ft	Delta ts ----- usec/ft	Comp. Velocity ----- ft/sec	Shear Velocity ----- ft/sec
----- psi	----- psi	----- psi	----- usec/ft	----- usec/ft	----- ft/sec	----- ft/sec
Sample: 11352 Porosity: 0.022 Bulk Density: 2.704						
700	200	500	5.46E+01	1.17E+02	1.83E+04	8.54E+03
1,700	200	1,500	5.38E+01	1.09E+02	1.86E+04	9.15E+03
3,700	200	3,500	5.29E+01	1.04E+02	1.89E+04	9.65E+03
6,700	200	6,500	5.17E+01	9.85E+01	1.93E+04	1.02E+04
700	200	500	5.68E+01	1.15E+02	1.76E+04	8.71E+03
Sample: 11353 Porosity: 0.038 Bulk Density: 2.696						
700	200	500	5.52E+01	1.17E+02	1.81E+04	8.52E+03
1,700	200	1,500	5.40E+01	1.10E+02	1.85E+04	9.09E+03
3,700	200	3,500	5.15E+01	1.03E+02	1.94E+04	9.75E+03
6,700	200	6,500	5.02E+01	9.68E+01	1.99E+04	1.03E+04
700	200	500	5.49E+01	1.18E+02	1.82E+04	8.51E+03
Sample: 11354 Porosity: 0.022 Bulk Density: 2.722						
700	200	500	5.45E+01	1.16E+02	1.83E+04	8.66E+03
1,700	200	1,500	5.33E+01	1.09E+02	1.88E+04	9.20E+03
3,700	200	3,500	5.17E+01	1.02E+02	1.93E+04	9.84E+03
6,700	200	6,500	5.03E+01	9.53E+01	1.99E+04	1.05E+04
700	200	500	5.49E+01	1.15E+02	1.82E+04	8.73E+03
Sample: 11355 Porosity: 0.012 Bulk Density: 2.705						
700	200	500	5.06E+01	1.04E+02	1.97E+04	9.58E+03
1,700	200	1,500	5.03E+01	1.01E+02	1.99E+04	9.91E+03
3,700	200	3,500	4.93E+01	9.73E+01	2.03E+04	1.03E+04
6,700	200	6,500	4.90E+01	9.51E+01	2.04E+04	1.05E+04
700	200	500	5.06E+01	1.05E+02	1.98E+04	9.54E+03
Sample: 11356 Porosity: 0.041 Bulk Density: 2.698						
700	200	500	5.58E+01	1.17E+02	1.79E+04	8.58E+03
1,700	200	1,500	5.26E+01	1.08E+02	1.90E+04	9.28E+03
3,700	200	3,500	5.17E+01	1.03E+02	1.94E+04	9.72E+03
6,700	200	6,500	5.08E+01	9.83E+01	1.97E+04	1.02E+04
700	200	500	5.50E+01	1.14E+02	1.82E+04	8.77E+03

Measurements by:

PBT, Inc. 303 East Street Golden, Colorado 80403 (303) 279 1647

Job 91003 5/6/91

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Table A-1 contd.

Contractor:	Contract: DE-AC22-91BC14655
Ikwaakolam Energy Company, Inc.	Well: Chevron Melby 4-1
2413 Washington Street	NWSW Sec 1 T33N R58E
Denver, Colorado 80205	Brush Lake Field
	Sheridan County, Montana

ROCK PROPERTY MEASUREMENTS

(POROSITY, DENSITY, COMPRESSIONAL AND SHEAR WAVE SLOWNESS AND VELOCITY)

Conf. Press.	Pore Press.	Effect. Press.	Delta tp	Delta ts	Comp. Velocity	Shear Velocity
----- psi -----			---- usec/ft ----		----- ft/sec -----	
Sample: 11357 Porosity: 0.015 Bulk Density: 2.715						
700	200	500	5.31E+01	1.17E+02	1.88E+04	8.55E+03
1,700	200	1,500	5.19E+01	1.10E+02	1.93E+04	9.12E+03
3,700	200	3,500	5.08E+01	1.04E+02	1.97E+04	9.64E+03
6,700	200	6,500	5.01E+01	9.86E+01	2.00E+04	1.01E+04
700	200	500	5.40E+01	1.17E+02	1.85E+04	8.55E+03
Sample: 11358 Porosity: 0.009 Bulk Density: 2.722						
700	200	500	4.96E+01	1.01E+02	2.02E+04	9.93E+03
1,700	200	1,500	4.91E+01	9.80E+01	2.03E+04	1.02E+04
3,700	200	3,500	4.86E+01	9.52E+01	2.06E+04	1.05E+04
6,700	200	6,500	4.83E+01	9.45E+01	2.07E+04	1.06E+04
700	200	500	5.07E+01	1.00E+02	1.97E+04	9.97E+03
Sample: 11359 Porosity: 0.049 Bulk Density: 2.673						
700	200	500	5.40E+01	1.10E+02	1.85E+04	9.09E+03
1,700	200	1,500	5.32E+01	1.04E+02	1.88E+04	9.57E+03
3,700	200	3,500	5.26E+01	1.01E+02	1.90E+04	9.92E+03
6,700	200	6,500	5.14E+01	9.61E+01	1.95E+04	1.04E+04
700	200	500	5.48E+01	1.09E+02	1.82E+04	9.20E+03
Sample: 11360 Porosity: 0.037 Bulk Density: 2.700						
700	200	500	5.28E+01	1.08E+02	1.90E+04	9.25E+03
1,700	200	1,500	5.17E+01	1.02E+02	1.94E+04	9.84E+03
3,700	200	3,500	5.10E+01	9.67E+01	1.96E+04	1.03E+04
6,700	200	6,500	4.93E+01	9.41E+01	2.03E+04	1.06E+04
700	200	500	5.26E+01	1.07E+02	1.90E+04	9.31E+03
Sample: 11361 Porosity: 0.009 Bulk Density: 2.738						
700	200	500	5.05E+01	1.04E+02	1.98E+04	9.60E+03
1,700	200	1,500	5.00E+01	1.00E+02	2.00E+04	9.99E+03
3,700	200	3,500	4.93E+01	9.77E+01	2.03E+04	1.02E+04
6,700	200	6,500	4.82E+01	9.55E+01	2.08E+04	1.05E+04
700	200	500	5.11E+01	1.02E+02	1.96E+04	9.79E+03

Measurements by:

PBT, Inc. 303 East Street Golden, Colorado 80403 (303) 279 1647

Job 91003 5/6/91

Table A-1 contd.

Contractor:	Contract: DE-AC22-91BC14655
Ikwaakolam Energy Company, Inc.	Well: Chevron Melby 4-1
2413 Washington Street	NWSW Sec 1 T33N R58E
Denver, Colorado 80205	Brush Lake Field
	Sheridan County, Montana

ROCK PROPERTY MEASUREMENTS

(POROSITY, DENSITY, COMPRESSIONAL AND SHEAR WAVE SLOWNESS AND VELOCITY)

Conf. Press.	Pore Press. psi	Effect. Press.	Delta tp usec/ft	Delta ts	Comp. Velocity ft/sec	Shear Velocity
Sample: 11362 Porosity: 0.019 Bulk Density: 2.712						
700	200	500	5.40E+01	1.14E+02	1.85E+04	8.80E+03
1,700	200	1,500	5.30E+01	1.09E+02	1.89E+04	9.21E+03
3,700	200	3,500	5.17E+01	1.04E+02	1.93E+04	9.60E+03
6,700	200	6,500	5.04E+01	9.86E+01	1.99E+04	1.01E+04
700	200	500	5.44E+01	1.12E+02	1.84E+04	8.94E+03
Sample: 11363 Porosity: 0.033 Bulk Density: 2.697						
700	200	500	5.51E+01	1.19E+02	1.82E+04	8.39E+03
1,700	200	1,500	5.34E+01	1.07E+02	1.87E+04	9.31E+03
3,700	200	3,500	5.15E+01	1.02E+02	1.94E+04	9.76E+03
6,700	200	6,500	5.08E+01	9.81E+01	1.97E+04	1.02E+04
700	200	500	5.64E+01	1.19E+02	1.77E+04	8.43E+03
Sample: 11364 Porosity: 0.036 Bulk Density: 2.726						
700	200	500	5.33E+01	1.13E+02	1.88E+04	8.82E+03
1,700	200	1,500	5.23E+01	1.04E+02	1.91E+04	9.61E+03
3,700	200	3,500	5.07E+01	1.00E+02	1.97E+04	9.97E+03
6,700	200	6,500	4.95E+01	9.54E+01	2.02E+04	1.05E+04
700	200	500	5.33E+01	1.12E+02	1.88E+04	8.91E+03
Sample: 11365 Porosity: 0.032 Bulk Density: 2.711						
700	200	500	5.32E+01	1.16E+02	1.88E+04	8.65E+03
1,700	200	1,500	5.27E+01	1.04E+02	1.90E+04	9.58E+03
3,700	200	3,500	5.13E+01	9.96E+01	1.95E+04	1.00E+04
6,700	200	6,500	4.92E+01	9.56E+01	2.03E+04	1.05E+04
700	200	500	5.36E+01	1.15E+02	1.86E+04	8.72E+03
Sample: 11366 Porosity: 0.016 Bulk Density: 2.769						
700	200	500	5.12E+01	1.07E+02	1.95E+04	9.36E+03
1,700	200	1,500	5.08E+01	1.04E+02	1.97E+04	9.64E+03
3,700	200	3,500	4.99E+01	1.01E+02	2.00E+04	9.95E+03
6,700	200	6,500	4.89E+01	9.51E+01	2.05E+04	1.05E+04
700	200	500	5.23E+01	1.06E+02	1.91E+04	9.42E+03

Measurements by:

PBT, Inc. 303 East Street Golden, Colorado 80403 (303) 279 1647

Job 91003 5/6/91

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Table A-1 contd.

Contractor:	Contract: DE-AC22-91BC14655
1kwuakolam Energy Company, Inc.	Well: Chevron Melby 4-1
2413 Washington Street	NWSW Sec 1 T33N R58E
Denver, Colorado 80205	Brush Lake Field
	Sheridan County, Montana

ROCK PROPERTY MEASUREMENTS

(POROSITY, DENSITY, COMPRESSIONAL AND SHEAR WAVE SLOWNESS AND VELOCITY)

Conf. Press.	Pore Press.	Effect. Press.	Delta tp ----- usec/ft	Delta ts ----- -----	Comp. Velocity ----- ft/sec	Shear Velocity ----- -----
Sample: 11367 Porosity: 0.019 Bulk Density: 2.725						
700	200	500	5.53E+01	1.16E+02	1.81E+04	8.60E+03
1,700	200	1,500	5.47E+01	1.08E+02	1.83E+04	9.26E+03
3,700	200	3,500	5.21E+01	1.02E+02	1.92E+04	9.77E+03
6,700	200	6,500	5.02E+01	9.81E+01	1.99E+04	1.02E+04
700	200	500	5.34E+01	1.13E+02	1.87E+04	8.82E+03
Sample: 11368 Porosity: 0.030 Bulk Density: 2.733						
700	200	500	5.20E+01	1.07E+02	1.92E+04	9.31E+03
1,700	200	1,500	5.11E+01	9.99E+01	1.96E+04	1.00E+04
3,700	200	3,500	4.96E+01	9.60E+01	2.02E+04	1.04E+04
6,700	200	6,500	4.87E+01	9.32E+01	2.05E+04	1.07E+04
700	200	500	5.30E+01	1.07E+02	1.89E+04	9.35E+03
Sample: 11369 Porosity: 0.022 Bulk Density: 2.700						
700	200	500	5.30E+01	1.15E+02	1.89E+04	8.70E+03
1,700	200	1,500	5.21E+01	1.07E+02	1.92E+04	9.31E+03
3,700	200	3,500	5.10E+01	1.02E+02	1.96E+04	9.81E+03
6,700	200	6,500	4.98E+01	9.71E+01	2.01E+04	1.03E+04
700	200	500	5.27E+01	1.14E+02	1.90E+04	8.74E+03
Sample: 11370 Porosity: 0.028 Bulk Density: 2.733						
700	200	500	5.23E+01	1.09E+02	1.91E+04	9.15E+03
1,700	200	1,500	5.17E+01	1.04E+02	1.93E+04	9.58E+03
3,700	200	3,500	5.05E+01	9.98E+01	1.98E+04	1.00E+04
6,700	200	6,500	4.88E+01	9.52E+01	2.05E+04	1.05E+04
700	200	500	5.23E+01	1.10E+02	1.91E+04	9.09E+03
Sample: 11371 Porosity: 0.018 Bulk Density: 2.756						
700	200	500	5.01E+01	1.03E+02	1.99E+04	9.69E+03
1,700	200	1,500	4.94E+01	9.85E+01	2.02E+04	1.02E+04
3,700	200	3,500	4.84E+01	9.48E+01	2.07E+04	1.05E+04
6,700	200	6,500	4.80E+01	9.12E+01	2.08E+04	1.10E+04
700	200	500	5.01E+01	1.01E+02	2.00E+04	9.86E+03

Measurements by:

PBT, Inc. 303 East Street Golden, Colorado 80403 (303) 279 1647

Job 91003 5/6/91

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Table A-1 contd.

Contractor:	Contract: DE-AC22-91BC14655
Ikwuakolam Energy Company, Inc.	Well: Chevron Melby 4-1
2413 Washington Street	NWSW Sec 1 T33N R58E
Denver, Colorado 80205	Brush Lake Field
	Sheridan County, Montana

ROCK PROPERTY MEASUREMENTS

(POROSITY, DENSITY, COMPRESSIONAL AND SHEAR WAVE SLOWNESS AND VELOCITY)

Conf. Press.	Pore Press.	Effect. Press.	Delta tp	Delta ts	Comp. Velocity	Shear Velocity
-----	psi	-----	---- usec/ft	----	----- ft/sec	-----
Sample: 11372 Porosity: 0.012 Bulk Density: 2.699						
700	200	500	5.59E+01	1.13E+02	1.79E+04	8.88E+03
1,700	200	1,500	5.48E+01	1.09E+02	1.82E+04	9.15E+03
3,700	200	3,500	5.38E+01	1.02E+02	1.86E+04	9.76E+03
6,700	200	6,500	5.24E+01	9.99E+01	1.91E+04	1.00E+04
700	200	500	6.31E+01	1.13E+02	1.59E+04	8.81E+03
Sample: 11374 Porosity: 0.042 Bulk Density: 2.728						
700	200	500	5.08E+01	1.05E+02	1.97E+04	9.49E+03
1,700	200	1,500	4.98E+01	9.96E+01	2.01E+04	1.00E+04
3,700	200	3,500	4.90E+01	9.34E+01	2.04E+04	1.07E+04
6,700	200	6,500	4.81E+01	9.08E+01	2.08E+04	1.10E+04
700	200	500	5.08E+01	1.06E+02	1.97E+04	9.46E+03
Sample: 11376 Porosity: 0.019 Bulk Density: 2.702						
700	200	500	5.16E+01	1.10E+02	1.94E+04	9.05E+03
1,700	200	1,500	5.12E+01	1.03E+02	1.95E+04	9.75E+03
3,700	200	3,500	5.05E+01	9.90E+01	1.98E+04	1.01E+04
6,700	200	6,500	4.99E+01	9.78E+01	2.00E+04	1.02E+04
700	200	500	5.33E+01	1.09E+02	1.88E+04	9.17E+03
Sample: 11378 Porosity: 0.019 Bulk Density: 2.727						
700	200	500	5.25E+01	1.13E+02	1.90E+04	8.88E+03
1,700	200	1,500	5.17E+01	1.05E+02	1.94E+04	9.50E+03
3,700	200	3,500	5.09E+01	1.00E+02	1.96E+04	9.97E+03
6,700	200	6,500	5.00E+01	9.61E+01	2.00E+04	1.04E+04
700	200	500	5.33E+01	1.13E+02	1.88E+04	8.89E+03
Sample: 11380 Porosity: 0.044 Bulk Density: 2.730						
700	200	500	5.07E+01	1.11E+02	1.97E+04	9.04E+03
1,700	200	1,500	5.01E+01	9.96E+01	2.00E+04	1.00E+04
3,700	200	3,500	4.92E+01	9.55E+01	2.03E+04	1.05E+04
6,700	200	6,500	4.74E+01	9.22E+01	2.11E+04	1.08E+04
700	200	500	4.99E+01	1.10E+02	2.00E+04	9.11E+03

Measurements by:

PBT, Inc. 303 East Street Golden, Colorado 80403 (303) 279 1647

Job 91003 5/6/91

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Table A-1 contd.

Contractor:	Contract: DE-AC22-91BC14655
Ikwuakolam Energy Company, Inc.	Well: Chevron Melby 4-1
2413 Washington Street	NWSW Sec 1 T33N R58E
Denver, Colorado 80205	Brush Lake Field
	Sheridan County, Montana

ROCK PROPERTY MEASUREMENTS

(POROSITY, DENSITY, COMPRESSIONAL AND SHEAR WAVE SLOWNESS AND VELOCITY)

Conf. Press.	Pore Press. psi	Effect. Press.	Delta tp ---- usec/ft ----	Delta ts ----	Comp. Velocity ----- ft/sec -----	Shear Velocity -----
Sample: 11382 Porosity: 0.011 Bulk Density: 2.749						
700	200	500	5.00E+01	1.03E+02	2.00E+04	9.75E+03
1,700	200	1,500	4.98E+01	1.01E+02	2.01E+04	9.94E+03
3,700	200	3,500	4.95E+01	9.77E+01	2.02E+04	1.02E+04
6,700	200	6,500	4.87E+01	9.65E+01	2.05E+04	1.04E+04
700	200	500	5.24E+01	1.02E+02	1.91E+04	9.77E+03
Sample: 11384 Porosity: 0.018 Bulk Density: 2.735						
700	200	500	4.80E+01	9.79E+01	2.08E+04	1.02E+04
1,700	200	1,500	4.77E+01	9.48E+01	2.10E+04	1.06E+04
3,700	200	3,500	4.77E+01	9.18E+01	2.10E+04	1.09E+04
6,700	200	6,500	4.69E+01	8.93E+01	2.13E+04	1.12E+04
700	200	500	4.92E+01	9.90E+01	2.03E+04	1.01E+04
Sample: 11386 Porosity: 0.051 Bulk Density: 2.723						
700	200	500	5.06E+01	1.09E+02	1.97E+04	9.17E+03
1,700	200	1,500	4.96E+01	9.94E+01	2.02E+04	1.01E+04
3,700	200	3,500	4.89E+01	9.49E+01	2.04E+04	1.05E+04
6,700	200	6,500	4.85E+01	9.19E+01	2.06E+04	1.09E+04
700	200	500	5.09E+01	1.10E+02	1.96E+04	9.11E+03
Sample: 11388 Porosity: 0.014 Bulk Density: 2.711						
700	200	500	4.96E+01	9.91E+01	2.02E+04	1.01E+04
1,700	200	1,500	4.92E+01	9.75E+01	2.03E+04	1.03E+04
3,700	200	3,500	4.89E+01	9.65E+01	2.04E+04	1.04E+04
6,700	200	6,500	4.86E+01	9.56E+01	2.06E+04	1.05E+04
700	200	500	4.99E+01	9.98E+01	2.00E+04	1.00E+04
Sample: 11390 Porosity: 0.010 Bulk Density: 2.706						
700	200	500	4.92E+01	1.00E+02	2.03E+04	9.98E+03
1,700	200	1,500	4.89E+01	9.85E+01	2.04E+04	1.01E+04
3,700	200	3,500	4.89E+01	9.67E+01	2.05E+04	1.03E+04
6,700	200	6,500	4.86E+01	9.57E+01	2.06E+04	1.04E+04
700	200	500	5.07E+01	1.00E+02	1.97E+04	1.00E+04

Measurements by:

PBT, Inc. 303 East Street Golden, Colorado 80403 (303) 279 1647

Job 91003 5/6/91

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Table A-1 contd.

Contractor:	Contract: DE-AC22-91BC14655
Ikwuakolam Energy Company, Inc.	Well: Chevron Melby 4-1
2413 Washington Street	NWSW Sec 1 T33N R58E
Denver, Colorado 80205	Brush Lake Field
	Sheridan County, Montana

ROCK PROPERTY MEASUREMENTS

(POROSITY, DENSITY, COMPRESSIONAL AND SHEAR WAVE SLOWNESS AND VELOCITY)

Conf. Press.	Pore Press. psi	Effect. Press.	Delta tp usec/ft	Delta ts	Comp. Velocity ft/sec	Shear Velocity
Sample: 11392 Porosity: 0.011 Bulk Density: 2.723						
700	200	500	5.03E+01	1.04E+02	1.99E+04	9.60E+03
1,700	200	1,500	4.99E+01	1.02E+02	2.00E+04	9.80E+03
3,700	200	3,500	4.96E+01	1.00E+02	2.02E+04	1.00E+04
6,700	200	6,500	4.90E+01	9.74E+01	2.04E+04	1.03E+04
700	200	500	5.10E+01	1.04E+02	1.96E+04	9.63E+03
Sample: 11394 Porosity: 0.013 Bulk Density: 2.722						
700	200	500	4.97E+01	9.94E+01	2.01E+04	1.01E+04
1,700	200	1,500	4.91E+01	9.70E+01	2.04E+04	1.03E+04
3,700	200	3,500	4.84E+01	9.40E+01	2.07E+04	1.06E+04
6,700	200	6,500	4.78E+01	9.29E+01	2.09E+04	1.08E+04
700	200	500	5.00E+01	9.97E+01	2.00E+04	1.00E+04
Sample: 11396 Porosity: 0.010 Bulk Density: 2.731						
700	200	500	4.91E+01	9.90E+01	2.04E+04	1.01E+04
1,700	200	1,500	4.89E+01	9.80E+01	2.05E+04	1.02E+04
3,700	200	3,500	4.87E+01	9.69E+01	2.05E+04	1.03E+04
6,700	200	6,500	4.83E+01	9.58E+01	2.07E+04	1.04E+04
700	200	500	4.92E+01	9.92E+01	2.03E+04	1.01E+04
Sample: 11398 Porosity: 0.013 Bulk Density: 2.722						
700	200	500	5.15E+01	1.06E+02	1.94E+04	9.43E+03
1,700	200	1,500	5.13E+01	1.03E+02	1.95E+04	9.70E+03
3,700	200	3,500	5.04E+01	1.00E+02	1.98E+04	9.97E+03
6,700	200	6,500	4.97E+01	9.71E+01	2.01E+04	1.03E+04
700	200	500	5.38E+01	1.06E+02	1.86E+04	9.46E+03
Sample: 11400 Porosity: 0.014 Bulk Density: 2.736						
700	200	500	5.18E+01	1.07E+02	1.93E+04	9.35E+03
1,700	200	1,500	5.13E+01	1.05E+02	1.95E+04	9.55E+03
3,700	200	3,500	5.09E+01	1.02E+02	1.97E+04	9.79E+03
6,700	200	6,500	5.01E+01	1.00E+02	2.00E+04	9.99E+03
700	200	500	5.51E+01	1.08E+02	1.82E+04	9.29E+03

Measurements by:

PBT, Inc. 303 East Street Golden, Colorado 80403 (303) 279 1647

Job 91003 5/6/91

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Table A-1 contd.

Contractor:	Contract: DE-AC22-91BC14655
Ikwuakolam Energy Company, Inc.	Well: Chevron Melby 4-1
2413 Washington Street	NWSW Sec 1 T33N R58E
Denver, Colorado 80205	Brush Lake Field
	Sheridan County, Montana

ROCK PROPERTY MEASUREMENTS

(POROSITY, DENSITY, COMPRESSIONAL AND SHEAR WAVE SLOWNESS AND VELOCITY)

Conf. Press.	Pore Press.	Effect. Press.	Delta tp ----- usec/ft -----	Delta ts -----	Comp. Velocity ----- ft/sec -----	Shear Velocity -----
-----	psi	-----	-----	-----	-----	-----
Sample: 11402 Porosity: 0.018 Bulk Density: 2.723						
700	200	500	5.22E+01	1.12E+02	1.92E+04	8.89E+03
1,700	200	1,500	5.18E+01	1.06E+02	1.93E+04	9.47E+03
3,700	200	3,500	5.07E+01	1.02E+02	1.97E+04	9.79E+03
6,700	200	6,500	5.01E+01	9.94E+01	2.00E+04	1.01E+04
700	200	500	5.18E+01	1.11E+02	1.93E+04	8.97E+03
Sample: 11404 Porosity: 0.012 Bulk Density: 2.729						
700	200	500	5.08E+01	1.05E+02	1.97E+04	9.57E+03
1,700	200	1,500	5.03E+01	1.01E+02	1.99E+04	9.88E+03
3,700	200	3,500	5.00E+01	9.82E+01	2.00E+04	1.02E+04
6,700	200	6,500	4.94E+01	9.54E+01	2.02E+04	1.05E+04
700	200	500	5.42E+01	1.07E+02	1.85E+04	9.37E+03
Sample: 11406 Porosity: 0.023 Bulk Density: 2.716						
700	200	500	5.23E+01	1.10E+02	1.91E+04	9.06E+03
1,700	200	1,500	5.16E+01	1.05E+02	1.94E+04	9.55E+03
3,700	200	3,500	5.06E+01	1.00E+02	1.98E+04	9.97E+03
6,700	200	6,500	4.95E+01	9.62E+01	2.02E+04	1.04E+04
700	200	500	5.26E+01	1.10E+02	1.90E+04	9.13E+03
Sample: 11408 Porosity: 0.012 Bulk Density: 2.717						
700	200	500	5.18E+01	1.05E+02	1.93E+04	9.52E+03
1,700	200	1,500	5.12E+01	1.03E+02	1.95E+04	9.73E+03
3,700	200	3,500	5.05E+01	9.96E+01	1.98E+04	1.00E+04
6,700	200	6,500	4.98E+01	9.81E+01	2.01E+04	1.02E+04
700	200	500	5.33E+01	1.09E+02	1.88E+04	9.16E+03
Sample: 11410 Porosity: 0.023 Bulk Density: 2.733						
700	200	500	5.13E+01	1.05E+02	1.95E+04	9.51E+03
1,700	200	1,500	5.06E+01	1.01E+02	1.98E+04	9.86E+03
3,700	200	3,500	4.96E+01	9.79E+01	2.02E+04	1.02E+04
6,700	200	6,500	4.88E+01	9.26E+01	2.05E+04	1.08E+04
700	200	500	5.21E+01	1.08E+02	1.92E+04	9.28E+03

Measurements by:

PBT, Inc. 303 East Street Golden, Colorado 80403 (303) 279 1647

Job 91003 5/6/91

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Table A-1 contd.

Contractor:
Ikwuakolam Energy Company, Inc.
2413 Washington Street
Denver, Colorado 80205

Contract: DE-AC22-91BC14655
Well: Chevron Melby 4-1
NWSW Sec 1 T33N R58E
Brush Lake Field
Sheridan County, Montana

ROCK PROPERTY MEASUREMENTS

(POROSITY, DENSITY, COMPRESSIONAL AND SHEAR WAVE SLOWNESS AND VELOCITY)

Conf. Press.	Pore Press.	Effect. Press.	Delta tp	Delta ts	Comp. Velocity	Shear Velocity
-----	psi	-----	---- usec/ft	----	----- ft/sec	-----
Sample: 11412 Porosity: 0.017 Bulk Density: 2.732						
700	200	500	5.17E+01	1.06E+02	1.93E+04	9.46E+03
1,700	200	1,500	5.13E+01	1.03E+02	1.95E+04	9.67E+03
3,700	200	3,500	5.07E+01	9.98E+01	1.97E+04	1.00E+04
6,700	200	6,500	5.04E+01	9.82E+01	1.98E+04	1.02E+04
700	200	500	5.46E+01	1.04E+02	1.83E+04	9.59E+03
Sample: 11414 Porosity: 0.018 Bulk Density: 2.709						
700	200	500	5.33E+01	1.15E+02	1.88E+04	8.66E+03
1,700	200	1,500	5.22E+01	1.08E+02	1.92E+04	9.26E+03
3,700	200	3,500	5.10E+01	1.04E+02	1.96E+04	9.66E+03
6,700	200	6,500	5.04E+01	9.89E+01	1.98E+04	1.01E+04
700	200	500	5.27E+01	1.15E+02	1.90E+04	8.73E+03
Sample: 11416 Porosity: 0.017 Bulk Density: 2.746						
700	200	500	5.21E+01	1.09E+02	1.92E+04	9.22E+03
1,700	200	1,500	5.05E+01	1.03E+02	1.98E+04	9.71E+03
3,700	200	3,500	5.00E+01	9.91E+01	2.00E+04	1.01E+04
6,700	200	6,500	4.92E+01	9.57E+01	2.03E+04	1.04E+04
700	200	500	5.34E+01	1.09E+02	1.87E+04	9.19E+03
Sample: 11418 Porosity: 0.014 Bulk Density: 2.723						
700	200	500	5.26E+01	1.11E+02	1.90E+04	8.98E+03
1,700	200	1,500	5.13E+01	1.06E+02	1.95E+04	9.41E+03
3,700	200	3,500	5.09E+01	1.01E+02	1.97E+04	9.87E+03
6,700	200	6,500	4.97E+01	9.92E+01	2.01E+04	1.01E+04
700	200	500	5.50E+01	1.10E+02	1.82E+04	9.11E+03
Sample: 11420 Porosity: 0.015 Bulk Density: 2.715						
700	200	500	5.22E+01	1.12E+02	1.92E+04	8.96E+03
1,700	200	1,500	5.16E+01	1.04E+02	1.94E+04	9.63E+03
3,700	200	3,500	5.13E+01	1.02E+02	1.95E+04	9.79E+03
6,700	200	6,500	5.08E+01	9.98E+01	1.97E+04	1.00E+04
700	200	500	5.22E+01	1.08E+02	1.92E+04	9.23E+03

Measurements by:

PBT, Inc. 303 East Street Golden, Colorado 80403 (303) 279 1647

Job 91003 5/6/91

25 of 29 of Velocity Data

Table A-1 contd.

Contractor:	Contract: DE-AC22-91BC14655
Ikwuakolam Energy Company, Inc.	Well: Chevron Melby 4-1
2413 Washington Street	NWSW Sec 1 T33N R58E
Denver, Colorado 80205	Brush Lake Field
	Sheridan County, Montana

ROCK PROPERTY MEASUREMENTS

(POROSITY, DENSITY, COMPRESSIONAL AND SHEAR WAVE SLOWNESS AND VELOCITY)

Conf. Press.	Pore Press.	Effect. Press.	Delta tp ----- usec/ft	Delta ts ----- -----	Comp. Velocity ----- ft/sec	Shear Velocity ----- -----
----- psi	----- psi	----- psi	----- usec/ft	----- -----	----- ft/sec	----- -----
Sample: 11422 Porosity: 0.019 Bulk Density: 2.718						
700	200	500	5.32E+01	1.13E+02	1.88E+04	8.84E+03
1,700	200	1,500	5.27E+01	1.10E+02	1.90E+04	9.09E+03
3,700	200	3,500	5.25E+01	1.07E+02	1.91E+04	9.35E+03
6,700	200	6,500	5.18E+01	1.02E+02	1.93E+04	9.76E+03
700	200	500	5.32E+01	1.12E+02	1.88E+04	8.95E+03
Sample: 11424 Porosity: 0.018 Bulk Density: 2.732						
700	200	500	5.22E+01	1.08E+02	1.91E+04	9.29E+03
1,700	200	1,500	5.17E+01	1.04E+02	1.93E+04	9.66E+03
3,700	200	3,500	5.09E+01	1.01E+02	1.96E+04	9.87E+03
6,700	200	6,500	5.04E+01	9.68E+01	1.98E+04	1.03E+04
700	200	500	5.40E+01	1.06E+02	1.85E+04	9.40E+03
Sample: 11426 Porosity: 0.020 Bulk Density: 2.728						
700	200	500	5.41E+01	1.21E+02	1.85E+04	8.25E+03
1,700	200	1,500	5.41E+01	1.19E+02	1.85E+04	8.37E+03
3,700	200	3,500	5.40E+01	1.16E+02	1.85E+04	8.63E+03
6,700	200	6,500	5.24E+01	1.19E+02	1.91E+04	8.42E+03
700	200	500	5.40E+01	1.18E+02	1.85E+04	8.45E+03
Sample: 11428 Porosity: 0.025 Bulk Density: 2.721						
700	200	500	5.31E+01	1.15E+02	1.88E+04	8.67E+03
1,700	200	1,500	5.27E+01	1.06E+02	1.90E+04	9.46E+03
3,700	200	3,500	5.16E+01	9.99E+01	1.94E+04	1.00E+04
6,700	200	6,500	5.02E+01	9.54E+01	1.99E+04	1.05E+04
700	200	500	5.39E+01	1.13E+02	1.85E+04	8.88E+03
Sample: 11430 Porosity: 0.019 Bulk Density: 2.712						
700	200	500	5.33E+01	1.16E+02	1.88E+04	8.63E+03
1,700	200	1,500	5.33E+01	1.09E+02	1.88E+04	9.14E+03
3,700	200	3,500	5.31E+01	1.05E+02	1.88E+04	9.51E+03
6,700	200	6,500	5.12E+01	1.01E+02	1.95E+04	9.94E+03
700	200	500	5.51E+01	1.14E+02	1.81E+04	8.78E+03

Measurements by:

PBT, Inc. 303 East Street Golden, Colorado 80403 (303) 279 1647

Job 91003 5/6/91

Table A-1 contd.

Contractor:	Contract: DE-AC22-91BC14655
Ikwuakolam Energy Company, Inc.	Well: Chevron Melby 4-1
2413 Washington Street	NWSW Sec 1 T33N R58E
Denver, Colorado 80205	Brush Lake Field
	Sheridan County, Montana

ROCK PROPERTY MEASUREMENTS

(POROSITY, DENSITY, COMPRESSIONAL AND SHEAR WAVE SLOWNESS AND VELOCITY)

Conf. Press.	Pore Press.	Effect. Press.	Delta tp	Delta ts	Comp. Velocity	Shear Velocity
-----	psi	-----	---- usec/ft ----	----	----- ft/sec -----	-----
Sample: 11432 Porosity: 0.013 Bulk Density: 2.701						
700	200	500	5.12E+01	1.04E+02	1.95E+04	9.64E+03
1,700	200	1,500	5.10E+01	1.01E+02	1.96E+04	9.92E+03
3,700	200	3,500	5.05E+01	9.79E+01	1.98E+04	1.02E+04
6,700	200	6,500	4.96E+01	9.69E+01	2.02E+04	1.03E+04
700	200	500	5.21E+01	1.04E+02	1.92E+04	9.65E+03
Sample: 11434 Porosity: 0.014 Bulk Density: 2.696						
700	200	500	5.15E+01	1.06E+02	1.94E+04	9.43E+03
1,700	200	1,500	5.11E+01	1.04E+02	1.96E+04	9.59E+03
3,700	200	3,500	5.07E+01	1.02E+02	1.97E+04	9.84E+03
6,700	200	6,500	5.02E+01	1.00E+02	1.99E+04	9.98E+03
700	200	500	5.39E+01	1.07E+02	1.85E+04	9.36E+03
Sample: 11436 Porosity: 0.019 Bulk Density: 2.725						
700	200	500	5.38E+01	1.14E+02	1.86E+04	8.80E+03
1,700	200	1,500	5.32E+01	1.07E+02	1.88E+04	9.34E+03
3,700	200	3,500	5.18E+01	1.03E+02	1.93E+04	9.72E+03
6,700	200	6,500	5.10E+01	9.83E+01	1.96E+04	1.02E+04
700	200	500	5.78E+01	1.11E+02	1.73E+04	8.97E+03
Sample: 11438 Porosity: 0.017 Bulk Density: 2.710						
700	200	500	5.34E+01	1.09E+02	1.87E+04	9.15E+03
1,700	200	1,500	5.28E+01	1.05E+02	1.89E+04	9.50E+03
3,700	200	3,500	5.18E+01	1.02E+02	1.93E+04	9.79E+03
6,700	200	6,500	5.08E+01	9.89E+01	1.97E+04	1.01E+04
700	200	500	5.66E+01	1.10E+02	1.77E+04	9.11E+03
Sample: 11440 Porosity: 0.015 Bulk Density: 2.702						
700	200	500	5.05E+01	1.03E+02	1.98E+04	9.71E+03
1,700	200	1,500	5.03E+01	1.00E+02	1.99E+04	9.98E+03
3,700	200	3,500	4.99E+01	9.83E+01	2.00E+04	1.02E+04
6,700	200	6,500	4.96E+01	9.69E+01	2.02E+04	1.03E+04
700	200	500	5.09E+01	1.02E+02	1.97E+04	9.78E+03

Measurements by:

PBT, Inc. 303 East Street Golden, Colorado 80403 (303) 279 1647

Job 91003 5/6/91

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Table A-1 contd.

Contractor:	Contract: DE-AC22-91BC14655
Ikwuakolam Energy Company, Inc.	Well: Chevron Melby 4-1
2413 Washington Street	NWSW Sec 1 T33N R58E
Denver, Colorado 80205	Brush Lake Field
	Sheridan County, Montana

ROCK PROPERTY MEASUREMENTS

(POROSITY, DENSITY, COMPRESSIONAL AND SHEAR WAVE SLOWNESS AND VELOCITY)

Conf. Press.	Pore Press.	Effect. Press.	Delta tp ----- usec/ft -----	Delta ts -----	Comp. Velocity ----- ft/sec -----	Shear Velocity -----
-----	psi	-----	-----	-----	-----	-----
Sample: 11442 Porosity: 0.013 Bulk Density: 2.703						
700	200	500	5.17E+01	1.08E+02	1.93E+04	9.26E+03
1,700	200	1,500	5.11E+01	1.04E+02	1.96E+04	9.60E+03
3,700	200	3,500	5.03E+01	1.01E+02	1.99E+04	9.89E+03
6,700	200	6,500	4.98E+01	9.74E+01	2.01E+04	1.03E+04
700	200	500	5.37E+01	1.09E+02	1.86E+04	9.15E+03
Sample: 11444 Porosity: 0.016 Bulk Density: 2.717						
700	200	500	5.12E+01	1.07E+02	1.95E+04	9.37E+03
1,700	200	1,500	5.06E+01	1.02E+02	1.98E+04	9.77E+03
3,700	200	3,500	5.02E+01	1.00E+02	1.99E+04	9.97E+03
6,700	200	6,500	4.93E+01	9.68E+01	2.03E+04	1.03E+04
700	200	500	5.25E+01	1.06E+02	1.90E+04	9.43E+03
Sample: 11446 Porosity: 0.015 Bulk Density: 2.715						
700	200	500	5.15E+01	1.06E+02	1.94E+04	9.48E+03
1,700	200	1,500	5.10E+01	1.02E+02	1.96E+04	9.81E+03
3,700	200	3,500	5.03E+01	9.85E+01	1.99E+04	1.02E+04
6,700	200	6,500	4.91E+01	9.62E+01	2.04E+04	1.04E+04
700	200	500	5.28E+01	1.04E+02	1.90E+04	9.62E+03
Sample: 11448 Porosity: 0.016 Bulk Density: 2.704						
700	200	500	5.24E+01	1.11E+02	1.91E+04	9.01E+03
1,700	200	1,500	5.21E+01	1.05E+02	1.92E+04	9.49E+03
3,700	200	3,500	5.10E+01	1.02E+02	1.96E+04	9.79E+03
6,700	200	6,500	5.03E+01	9.76E+01	1.99E+04	1.02E+04
700	200	500	5.36E+01	1.10E+02	1.86E+04	9.12E+03
Sample: 11450 Porosity: 0.015 Bulk Density: 2.694						
700	200	500	5.19E+01	1.11E+02	1.93E+04	9.02E+03
1,700	200	1,500	5.15E+01	1.05E+02	1.94E+04	9.56E+03
3,700	200	3,500	5.08E+01	1.02E+02	1.97E+04	9.76E+03
6,700	200	6,500	5.01E+01	1.00E+02	2.00E+04	9.98E+03
700	200	500	5.33E+01	1.09E+02	1.88E+04	9.21E+03

Measurements by:

PBT, Inc. 303 East Street Golden, Colorado 80403 (303) 279 1647

Job 91003 5/6/91

28 of 29 of Velocity Data

Table A-1 contd.

Contractor:	Contract: DE-AC22-91BC14655
Ikwuakolam Energy Company, Inc.	Well: Chevron Melby 4-1
2413 Washington Street	NWSW Sec 1 T33N R58E
Denver, Colorado 80205	Brush Lake Field
	Sheridan County, Montana

ROCK PROPERTY MEASUREMENTS

(POROSITY, DENSITY, COMPRESSIONAL AND SHEAR WAVE SLOWNESS AND VELOCITY)

Conf. Press.	Pore Press.	Effect. Press.	Delta tp	Delta ts	Comp. Velocity	Shear Velocity
-----	psi	-----	---- usec/ft	----	----- ft/sec	-----
Sample: 11452 Porosity: 0.012 Bulk Density: 2.692						
700	200	500	5.24E+01	1.11E+02	1.91E+04	9.04E+03
1,700	200	1,500	5.17E+01	1.06E+02	1.93E+04	9.43E+03
3,700	200	3,500	5.09E+01	1.01E+02	1.97E+04	9.93E+03
6,700	200	6,500	5.06E+01	9.78E+01	1.98E+04	1.02E+04
700	200	500	5.33E+01	1.09E+02	1.88E+04	9.16E+03

Measurements by:

PBT, Inc. 303 East Street Golden, Colorado 80403 (303) 279 1647

Job 91003 5/6/91

29 of 29 of Velocity Data

APPENDIX B

**Crossplots Used for Quantitative Characterization
of the Red River "C" Zone Carbonates.**

Well: Chevron Melby #4-1
NWSW Sec. 1 T33N R58E
Brush Lake Field
Sheridan County, Montana

Note: Only measurements from the first 100 samples out of 141 were used in most of the crossplots. For the crossplots involving Eq. 6, at 1500 psi effective stress, the entire 141 samples were plotted.

-----SIP PLOT-----
of

Melby #4-1 at 500 psi
NWSH 1-33N-58E, Sheridan Co. MT

Figure B-1. Compressional wave interval transit-time versus core porosity "C" zone unsorted, 500 psi effective stress.

-----SIP PLOT-----

of
Melby #4-1 at 1500 psi
NWSW 1-33N-58E, Sheridan Co. MT

Figure B-2. Compressional wave interval transit-time versus core porosity "C" zone unsorted, 1500 psi effective stress.

-----SIP PLOT-----
of

Melby #4-1 at 3500 psi
NASW 1-33N-58E, Sheridan Co. MT

Figure B-3. Compressional wave interval transit-time versus core porosity "C" zone unsorted, 3500 psi effective stress.

-----SIP PLOT-----

of
Melby #4-1 at 6500 psi
NMSW 1-33N-58E, Sheridan Co., MT

Figure B-4. Compressional wave interval transit-time versus core porosity "C" zone unsorted, 6500 psi effective stress.

-----SIP PLOT-----

of
 Well #4-1 at 500 psi
 NASW 1-33N-58E, Sheridan Co. MT

Figure B-5. Shear wave interval transit-time versus core porosity "C" zone unsorted, 500 psi effective stress.

-----SIP PLOT-----

of
Melby #4-1 at 1500 psi
NASH 1-33N-58E, Sheridan Co. MT

Figure B-6. Shear wave interval transit-time versus core porosity "C" zone unsorted, 1500 psi effective stress.

-----SIP PLOT-----

of
Wellby #4-1 at 3500 psi
NW 1/4-33N-58E, Sheridan Co. MT

Figure B-7. Shear wave interval transit-time versus core porosity "C" zone unsorted, 3500 psi effective stress.

-----SIP PLOT-----

of
Melby #4-1 at 6500 psi
NWSW 1-33N-58E, Sheridan Co., MT

Figure B-8. Shear wave interval transit-time versus core porosity "C" zone unsorted, 6500 psi effective stress.

-----SIP PLOT-----
of

Melby #4-1 at 500 psi
NWSW 1-33N-56E, Sheridan Co. MT

Figure B-9. Vp/Vs ratio versus Vp, "C" zone unsorted, 500 psi effective stress.

-----SIP PLOT-----

of
Melby #4-1 at 1500 psi
NWSW 1-33N-58E, Sheridan Co. MT

Figure B-10. Vp/Vs ratio versus Vp, "C" zone unsorted, 1500 psi effective stress.

-----SIP PLOT-----

of
Melby #4-1 at 3500 psi
NWSW 1-33N-58E, Sheridan Co. MT

Figure B-11. Vp/Vs ratio versus Vp, "C" zone unsorted, 3500 psi effective stress.

-----SIP PLOT-----

of
Melby #4-1 at 6500 psi
NWSW 1-33N-58E, Sheridan Co. MT

Figure B-12. Vp/Vs ratio versus Vp, "C" zone unsorted, 6500 psi effective stress.

-----SIP PLOT-----

of
Melby #4-1 at 500 psi
NWSW 1-33N-58E, Sheridan Co. MT

Figure B-13. Compressional wave interval transit-time versus core porosity "C" zone laminated and burrowed intervals, 500 psi effective stress.

-----SIP PLOT-----

of
Melby #4-1 at 1500 psi
NWSW 1-33N-58E, Sheridan Co. MT

Figure B-14. Compressional wave interval transit-time versus core porosity
"C" zone laminated and burrowed intervals, 1500 psi effective stress.

-----SIP PLOT-----

of
Melby #4-1 at 3500 psi
NW 1-33N-58E, Sheridan Co., MT

Figure B-15. Compressional wave interval transit-time versus core porosity "C" zone laminated and burrowed intervals, 3500 psi effective stress.

-----SIP PLOT-----

of
Melby #4-1 at 6500 psi
NMSW 1-33N-58E, Sheridan Co. MT

Figure B-16. Compressional wave interval transit-time versus core porosity
"C" zone laminated and burrowed intervals, 6500 psi effective stress.

-----SIP PLOT-----

of
 Wellby #4-1 at 500 psi
 NASH 1-33N-58E, Sheridan Co., MT

Figure B-17. Shear wave interval transit-time versus core porosity "C" zone laminated and burrowed intervals, 500 psi effective stress.

-----SIP PLOT-----

of
Melby #4-1 at 1500 psi
NMSW 1-33N-58E, Sheridan Co. MT

Figure B-18. Shear wave interval transit-time versus core porosity
"C" zone laminated and burrowed intervals, 1500 psi effective stress.

-----SIP PLOT-----

of
Wellb #4-1 at 3500 psi
NMSH 1-33N-58E, Sheridan Co. NT

Figure B-19. Shear wave interval transit-time versus core porosity "C" zone laminated and burrowed intervals, 3500 psi effective stress.

-----SIP PLOT-----

of
Melby #4-1 at 6500 psi
NMSW 1-33N-58E, Sheridan Co., MT

Figure B-20. Shear wave interval transit-time versus core porosity "C" zone laminated and burrowed intervals, 6500 psi effective stress.

-----SIP PLOT-----
of

Melby #4-1 at 500 psi
NASH 1-33N-58E, Sheridan Co. MT

Figure B-21. Vp/Vs ratio versus Vp, "C" zone laminated and burrowed intervals, 500 psi effective stress.

-----SIP PLOT-----

of
Melby #4-1 at 1500 psi
NWSW 1-33N-58E, Sheridan Co. MT

Figure B-22. V_p/V_s ratio versus V_p , "C" zone laminated and burrowed intervals, 1500 psi effective stress.

-----SIP PLOT-----

of
Melby #4-1 at 3500 psi
NWSW 1-33N-58E, Sheridan Co. MT

Figure B-23. V_p/V_s ratio versus V_p , "C" zone laminated and burrowed intervals, 3500 psi effective stress.

-----SIP PLOT-----

of
Melby #4-1 at 6500 psi
NWSW 1-33N-58E, Sheridan Co. MT

Figure B-24. Vp/Vs ratio versus Vp, "C" zone laminated and burrowed intervals, 6500 psi effective stress.

APPENDIX C

Rock-typing crossplots for all the 51 wells studied, excluding the key well. Iso-Rock-Property (IRP) lines are not shown. The degree of scatter of data points indicates the sensitivity of individual crossplots to the reservoir heterogeneity.

-----SIP PLOT-----

Anderson #1
 sene 9-32N-56E, Sheridan Co. MT

Figure C-1a. Crossplot bulk density versus crossplot porosity.

-----SIP PLOT-----

Anderson #1
of
sene 9-32N-56E, Sheridan Co. MT

Figure C-1b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

Anderson #1
of
sene 9-32N-56E, Sheridan Co. MT

Figure C-1c. Crossplot interval transit-time versus bulk density.

-----SIP PLOT-----

of
Francis Larson #1
new 10-32N-56E, Sheridan Co., MT

Figure C-2a. Crossplot bulk density versus crossplot porosity.

-----SIP PLOT-----

of
Francis Larson #1
new 10-32N-56E, Sheridan Co. MT

Figure C-2b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of
Francis Larson #1
new 10-32N-56E, Sheridan Co. MT

17:01:46

Figure C-2c. Crossplot interval transit-time versus bulk density.

-----SIP PLOT-----

of
N.W. Natl. Life #31-12
name 12-32N-56E, Sheridan Co. MT

Figure C-3a. Crossplot bulk density versus crossplot porosity.

-----SIP PLOT-----

of
N.W. Nat'l, Life #31-12
name 12-32N-56E

Figure C-3b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of
N.W. Natl. Life 31-12
name 12-32N-56E, Sheridan Co. MT

Figure C-3c. Crossplot interval transit-time versus bulk density.

-----SIP PLOT-----

of
Ator #2
nese 21-32N-56E, Sheridan Co. MT

Figure C-4a. Crossplot bulk density versus crossplot porosity.

-----SIP PLOT-----

of
Ator #2
nese 21-32N-56E, Sheridan Co. MT

10-27-1992

18:19:11

Figure C-4b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of
Ator #2
nase 21-32N-56E, Sheridan Co. MT

11:26:08

Figure C-4c. Crossplot interval transit-time versus bulk density.

-----SIP PLOT-----

of
Tronson #1
nenw 27-32N-56E, Sheridan Co. MT

17:51:20

Figure C-5a. Crossplot bulk density versus crossplot porosity.

-----SIP PLOT-----

of
Tronson #1
new 27-32N-56E, Sheridan Co., MT

Figure C-5b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of
Tronson #1
new 27-32N-56E, Sheridan Co. MT

10-30-1992

11:49:58

Figure C-5c. Crossplot interval transit-time versus bulk density.

-----SIP PLOT-----

of
FLB Peterson #1
s/2 sw/4 1-32N-57E, Sheridan Co. MT

10-21-1992

17:20:27

Figure C-6a. Crossplot bulk density versus crossplot porosity.

-----SIP PLOT-----

of
FLB Peterson #1
s/2 sw/4 1-32N-57E, Sheridan Co. MT

10-21-1992

17:13:12

Figure C-6b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of
FLB Peterson #1
s/2 SW/4 1-32N-57E, Sheridan Co. MT

Figure C-6c. Crossplot interval transit-time versus bulk density.

-----SIP PLOT-----

of
Marie Stromberg #1-2-4C
sew 2-32N-57E, Sheridan Co. MT

10-29-1992

11:35:00

Figure C-7a. Crossplot bulk density versus crossplot porosity.

-----SIP PLOT-----

of
Marie Stromberg #1-2-4C
sew 2-32N-57E, Sheridan Co. MT

Figure C-7b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of
Marie Stromberg #1-2-4C
sew 2-32N-57E, Sheridan Co. MT

Figure C-7c. Crossplot interval transit-time versus bulk density.

-----SIP PLOT-----

of
Ferryhough-Mill, #32-7
some 7-32N-57E, Sheridan Co., MT

10-28-1992

18:43:20

Figure C-8a. Crossplot bulk density versus crossplot porosity.

-----SIP PLOT-----

of
Ferryhough-Will, #32-7
zone 7-32N-57E, Sheridan Co. MT

17:52:24

10-27-1992

Figure C-8b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of
Ferryhough-Hill, #32-7
some 7-32N-57E, Sheridan Co. MT

Figure C-8c. Crossplot interval transit-time versus bulk density.

-----SIP PLOT-----

of
Tronson #1-8
SWNW 8-32N-57E, Sheridan Co. MT

Figure C-9a. Crossplot bulk density versus crossplot porosity.

-----SIP PLOT-----

of
Tronson #1-8
SWNW 8-32N-57E, Sheridan Co. MT

16:34:42

Figure C-9b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of
Tronson #1-8
SWNW 8-32N-57E, Sheridan Co. MT

16:44:16

Figure C-9c. Crossplot interval transit-time versus bulk density.

-----SIP PLOT-----

of
Stevens Sweet R. #1-10-2B
nene 10-32N-57E, Sheridan Co., MT

Figure C-10a. Crossplot bulk density versus crossplot porosity.

-----SIP PLOT-----

of
Stevens Sweet R. #1-10-2B
nene 10-32N-57E, Sheridan Co. MT

Figure C-10b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of
Stevens Sweet R. #1-10-2B
nene 10-32N-57E, Sheridan Co. MT

Figure C-10c. Crossplot interval transit-time versus bulk density.

-----SIP PLOT-----

of
Stromberg #1
new 11-32N-57E, Sheridan Co. MT

10-28-1992

17:25:10

Figure C-11a. Crossplot bulk density versus crossplot porosity.

-----SIP PLOT-----

of
Stromberg #1
new 11-32N-57E, Sheridan Co., MT

Figure C-11b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of
Stromberg #1
new 11-32N-57E, Sheridan Co. MT

12:15:10

10-30-1992

Figure C-11c. Crossplot interval transit-time versus bulk density.

-----SIP PLOT-----

of
Federal Stringer #1
NWNE 14-32N-57E, Sheridan Co. MT

Figure C-12a. Crossplot bulk density versus crossplot porosity.

-----SIP PLOT-----

of
Federal Stringer #1
nwne 14-32N-57E, Sheridan Co. MT

10-21-1992

17:47:35

Figure C-12b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of
Federal Stringer #1
name 14-32N-57E, Sheridan Co. MT

Figure C-12c. Crossplot interval transit-time versus bulk density.

-----SIP PLOT-----

of
Olson #1-20
SW/4 20-32N-57E, Sheridan Co. MT

11-02-1992

13:34:27

Figure C-13a. Crossplot bulk density versus crossplot porosity.

-----SIP PLOT-----

of
Olson #1-20
SW/4 20-32N-57E, Sheridan Co. MT

Figure C-13b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of
Olson #1-20
SW/4 20-32N-57E, Sheridan Co. MT

Figure C-13c. Crossplot interval transit-time versus bulk density.

-----SIP PLOT-----

of
Cartwright #1-25
senw 25-32N-57E, Sheridan Co., MT

Figure C-14a. Crossplot bulk density versus crossplot porosity.

-----SIP PLOT-----

of
Cartwright #1-25
senw 25-32N-57E, Sheridan Co., MT

12:13:36

10-28-1992

Figure C-14b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of
Cartwright #1-25
senw 25-32N-57E, Sheridan Co. MT

12:24:36

Figure C-14c. Crossplot interval transit-time versus bulk density.

-----SIP PLOT-----

of
Siggard #1
nwne 2-32N-58E, Sheridan Co. MT

10-28-1992

19:28:18

Figure C-15a. Crossplot bulk density versus crossplot porosity.

-----SIP PLOT-----

of
Siggard #1
nwne 2-32N-58E, Sheridan Co. MT

17:04:54

Figure C-15b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of
Siggard #1
nwne 2-32N-58E, Sheridan Co. MT

Figure C-15c. Crossplot interval transit-time versus bulk density.

-----SIP PLOT-----

of
Christensen #1
swne 3-32n-58E, Sheridan Co. MT

Figure C-16a. Crossplot bulk density versus crossplot porosity.

-----SIP PLOT-----

of
Christensen #1
swne 3-32N-58E, Sheridan Co. MT

13:28:59

10-22-1992

Figure C-16b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of
Christensen #1
SWNE 3-32N-58E, Sheridan Co. MT

13:33:45

Figure C-16c. Crossplot interval transit-time versus bulk density.

-----SIP PLOT-----

of
 NYBY #1-6
 nese 6-32N-58E, Sheridan Co. MT

Figure C-17a. Crossplot bulk density versus crossplot porosity.

-----SIP PLOT-----

of
NYPY #1-6
nese 6-32N-58E, Sheridan Co., MT

Figure C-17b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of
 NYBY #1-6
 nese 6-32N-58E, Sheridan Co. MT

17:17:17

Figure C-17c. Crossplot interval transit-time versus bulk density.

-----SIP PLOT-----

of
Christensen #1
seew 12-32N-58E, Sheridan Co. MT

Figure C-18a. Crossplot bulk density versus crossplot porosity.

-----SIP PLOT-----

of
Christensen #1
sew 12-32N-58E, Sheridan Co., MT

13:58:31

10-28-1992

Figure C-18b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of
Christensen No. 1
sew 12-32N-58E, Sheridan Co. MT

Figure C-18c. Crossplot interval transit-time versus bulk density.

-----SIP PLOT-----

of

Rasmussen #13-2

nwne 13-32N-58E, Sheridan Co., MT

11-02-1992

14:11:44

Figure C-19a. Crossplot bulk density versus crossplot porosity.

-----SIP PLOT-----

of
Rasmussen #13-2
nwne 13-32N-58E, Sheridan Co. MT

Figure C-19b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of
Rasmussen #13-2
nwne 13-32N-58E, Sheridan Co., MT

10-29-1992

13:41:27

Figure C-19c. Crossplot interval transit-time versus bulk density.

-----SIP PLOT-----

of
Willie Bee #2
swne 24-32N-58E, Sheridan Co. MT

13:18:23

10-22-1992

Figure C-20a. Crossplot bulk density versus crossplot porosity.

-----SIP PLOT-----

of
Willie Bee #2
swne 24-32N-58E, Sheridan Co. MT

Figure C-20b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of
Willie Bee #2
swne 24-32N-58E, Sheridan Co. MT

Figure C-20c. Crossplot interval transit-time versus bulk density.

-----SIP PLOT-----

of
Union Mortgage #1-29
nese 29-32N-58E, Sheridan Co. MT

Figure C-21a. Crossplot bulk density versus crossplot porosity.

-----SIP PLOT-----

of
Union Mortgage #1-29
nese 29-32N-58E, Sheridan Co. MT

Figure C-21b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of
Union Mortgage #1-29
nese 29-32N-58E, Sheridan Co, MT

Figure C-21c. Crossplot interval transit-time versus bulk density.

-----SIP PLOT-----

of
Bagaason #1-9
sese 9-32N-59E, Sheridan Co. MT

19:32:31

Figure C-22a. Crossplot bulk density versus crossplot porosity.

-----SIP PLOT-----

of
Bagaason #1-9
seese 9-32N-59E, Sheridan Co. MT

16:59:35

10-27-1992

Figure C-22b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of
Bagaason #1-9
sese 9-32N-59E, Sheridan Co. MT

14:24:41

Figure C-22c. Crossplot interval transit-time versus bulk density.

-----SIP PLOT-----

of
Maline Eidness #1
SWSW 6-33N-56E, Sheridan Co., MT

-----SIP PLOT-----

of
Maline Eidness #1
SWSW 6-33N-56E, Sheridan Co. MT

Figure C-23b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of
Maline Eidness #1
SWSW 6-33N-56E, Sheridan Co. MT

13:01:25

Figure C-23c. Crossplot interval transit-time versus bulk density.

-----SIP PLOT-----

of
Vera Strand #1-21
sege 21-33N-56E, Sheridan Co. MT

-----SIP PLOT-----

of
Vera Strand No.1-21
sese 21-33N-56E, Sheridan Co., MT

Figure C-24b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of
Uera Strand #1-21
sese 21-33N-56E, Sheridan Co. MT

14:06:40

Figure C-24c. Crossplot interval transit-time versus bulk density.

-----SIP PLOT-----

of
Holmgaard #1-27
SESW 27-33N-56E, Sheridan Co., MT

10-29-1992

11:39:39

Figure C-25a. Crossplot bulk density versus crossplot porosity.

-----SIP PLOT-----

of
Holmgard #1-27
sew 27-33N-56E, Sheridan Co. MT

Figure C-25b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of

Holmgard #1-27

seew 27-33N-56E, Sheridan Co. MT

10-29-1992

14:19:45

Figure C-25c. Crossplot interval transit-time versus bulk density.

-----SIP PLOT-----

of
Williams #1-34
SESW 34-33N-56E, Sheridan Co., MT

16:58:49

Figure C-26a. Crossplot bulk density versus crossplot porosity.

-----SIP PLOT-----

of
Williams #1-34
sew 34-33N-56E, Sheridan Co. MT

Figure C-26b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of
Williams #1-34
seesw 34-33N-56E, Sheridan Co. MT

12:46:39

Figure C-26c. Crossplot interval transit-time versus bulk density.

-----SIP PLOT-----

of
Sun Sundsted #1
nenw 6-33N-57E, Sheridan Co. MT

-----SIP PLOT-----

of
Sun Sundsted #1
new 6-33N-57E, Sheridan Co. MT

Figure C-27b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of
Sun Sundsted #1
new 6-33N-57E, Sheridan Co. MT

10-30-1992

13:03:51

Figure C-27c. Crossplot interval transit-time versus bulk density.

-----SIP PLOT-----

of
Astrup #1
SWNW 11-33N-57E, Sheridan Co. MT

10-29-1992

11:48:25

Figure C-28a. Crossplot bulk density versus crossplot porosity.

-----SIP PLOT-----

of
Astrup #1
SWNW 11-33N-57E, Sheridan Co., MT

10-27-1992

16:10:18

Figure C-28b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of

Astrop #1

SWNW 11-33N-57E, Sheridan Co. MT

Figure C-28c. Crossplot interval transit-time versus bulk density

-----SIP PLOT-----

of

Madsen #1-17
SWNW 17-33N-57E, Sheridan Co. MT

Figure C-29a. Crossplot bulk density versus crossplot porosity.

-----SIP PLOT-----

of
Madsen #1-17
SWNW 17-33N-57E, Sheridan Co. MT

Figure C-29b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of
Madsen #1-17
SWNW 17-33N-57E, Sheridan Co. MT

Figure C-29c, Crossplot interval transit-time versus bulk density.

-----SIP PLOT-----

of
Groskurth Peterson #1-21
SWNW 21-33N-57E, Sheridan Co. MT

-----SIP PLOT-----

of
Groskurth Petersen #1-21
SWNW 21-33N-57E, Sheridan Co. MT

17:29:59

10-27-1992

Figure C-30b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of
Groskurth Petersen #1-21
SWNW 21-33N-57E, Sheridan Co. MT

Figure C-30c. Crossplot interval transit-time versus bulk density.

-----SIP PLOT-----

Patrick-W. Gulf Miller #2
of
nwse 28-33N-57E, Sheridan Co., MT

-----SIP PLOT-----

of
Patrick-W.-Gulf Miller #2
NWSE 28-33N-57E, Sheridan Co. MT

10-27-1992

16:53:10

Figure C-31b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of
Patrick-W. Gulf. Miller #2
nwse 28-33N-57E, Sheridan Co. MT

Figure C-31c. Crossplot interval transit-time versus bulk density.

-----SIP PLOT-----

of
Clear Lake #1-5
NNNW 5-33N-58E, Sheridan Co. MT

Figure C-33a. Crossplot bulk density versus crossplot porosity.

-----SIP PLOT-----

of
Clear Lake #1-5
nnnw 5-33N-58E, Sheridan Co., MT

Figure C-33b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of
Clear Lake #1-5
nnnw 5-33N-58E, Sheridan Co. MT

11:32:42

Figure C-33c. Crossplot interval transit-time versus bulk density.

-----SIP PLOT-----

of
 Guenther #2-8
 swne 8-33N-58E, Sheridan Co., MT

Figure C-34a. Crossplot bulk density versus crossplot porosity.

-----SIP PLOT-----

of
Guenther #2-8
swne 8-33N-58E, Sheridan Co. MT

Figure C-34b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of
Guenther #2-8
swne 8-33N-58E, Sheridan Co., MT

11:55:52

Figure C-34c. Crossplot interval transit-time versus bulk density.

-----SIP PLOT-----

of
PPC-AM, #1 Guenther Anderson
nese 17-33N-58E, Sheridan Co. MT

13:02:25

10-29-1992

Figure C-35a: Crossplot bulk density versus crossplot porosity.

-----SIP PLOT-----

of
PPC-AM, #1 Guenther Anderson
nese 17-33N-58E, Sheridan Co. MT

10-27-1992

15:46:19

Figure C-35b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of
PPC-AM, #1 Guenther Anderson
nese 17-33N-58E, Sheridan Co., MT

Figure C-35c. Crossplot interval transit-time versus bulk density.

-----SIP PLOT-----

of
Sampson #1-21
NWSE 21-33N-58E, Sheridan Co. MT

Figure C-36a. Crossplot bulk density versus crossplot porosity.

-----SIP PLOT-----

of
Sampson #1-21
NWSE 21-33N-58E, Sheridan Co. MT

Figure C-36b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of
Sampson #1-21
nwse 21-33N-58E, Sheridan Co. MT

12:51:33

Figure C-36c. Crossplot interval transit-time versus bulk density.

-----SIP PLOT-----

of
Arneklev #1
NW/4 5-34N-56E, Sheridan Co. MT

11:44:20

Figure C-37a. Crossplot bulk density versus crossplot porosity.

-----SIP PLOT-----

of
Anneklev #1
nw/4 5-34N-56E, Sheridan Co. MT

16:17:37

10-27-1992

Figure C-37b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of
Arneklev #1
NW 1/4 5-34N-56E, Sheridan Co., MT

Figure C-37c. Crossplot interval transit-time versus bulk density.

-----SIP PLOT-----

of
Josie Larsh #14-1
sene 14-34N-56E, Sheridan Co. MT

Figure C-38a. Crossplot bulk density versus crossplot porosity.

-----SIP PLOT-----

of
Josie Larsh #14-1
sene 14-34N-56E, Sheridan Co. MT

Figure C-38b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of
Josie Larsh #14-1
sene 14-34N-56E, Sheridan Co. MT

Figure C-38c. Crossplot interval transit-time versus bulk density.

-----SIP PLOT-----

of
Johansen et al #1
nwse 25-34N-56E, Sheridan Co. MT

19:14:56

Figure C-39a. Crossplot bulk density versus crossplot porosity.

-----SIP PLOT-----

of
Johansen et al #1
nwse 25-34N-56E, Sheridan Co. MT

10-27-1992

17:24:25

Figure C-39b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of
Johansen et al #1
nwse 25-34N-56E, Sheridan Co. MT

Figure C-39c. Crossplot interval transit-time versus bulk density.

-----SIP PLOT-----

of
 Nettie Olson #1-28-1B
 new 28-33N-56E, Sheridan Co. MT

17:34:28

10-28-1992

Figure C-40a. Crossplot bulk density versus crossplot porosity.

-----SIP PLOT-----

of
 Nettie Olson #1-28-1B
 new 28-34N-56E, Sheridan Co. MT

Figure C-40b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of
Nettie Olson #1-28-1B
new 28-34N-56E, Sheridan Co. MT

Figure C-40c. Crossplot interval transit-time versus bulk density.

-----SIP PLOT-----

of
 Christianson #1-A
 sesw 15-34N-57E, Sheridan Co. MT

18:07:33

10-28-1992

Figure C-41a. Crossplot bulk density versus crossplot porosity.

-----SIP PLOT-----

of
 Christianson #1-A
 sesw 15-34N-57E, Sheridan Co. MT

Figure C-41b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of
Christianson #1-A
seew 15-34N-57E, Sheridan Co. MT

Figure C-41c. Crossplot interval transit-time versus bulk density.

-----SIP PLOT-----

of
Christensen #1
SENW 22-34N-57E, Sheridan Co. MT

Figure C-42a. Crossplot bulk density versus crossplot porosity.

-----SIP PLOT-----

of
Christensen #1
SWNW 22-34N-57E, Sheridan Co. MT

Figure C-42b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of
Christensen #1
SWNW 22-34N-57E, Sheridan Co. MT

11:20:55

Figure C-42c. Crossplot interval transit-time versus bulk density.

-----SIP PLOT-----

of
Haaven #1-25
NW 25-34N-58E, Sheridan Co. MT

Figure C-43a. Crossplot bulk density versus crossplot porosity.

-----SIP PLOT-----

of
Haaven #1-25
nw 25-34N-58E, Sheridan Co. MT

Figure C-43b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of
Haaven #1-25
nw 25-34N-58E, Sheridan Co., MT

Figure C-43c. Crossplot interval transit-time versus bulk density.

-----SIP PLOT-----

of

Morken #1

swne 27-34N-58E, Sheridan Co. MT

10-28-1992

17:03:22

Figure C-44a. Crossplot bulk density versus crossplot porosity.

-----SIP PLOT-----

of
Morken #1
swne 27-34N-58E, Sheridan Co. MT

Figure C-44b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of
Morken #1
swne 27-34N-58E, Sheridan Co. MT

12:42:27

Figure C-44c. Crossplot interval transit-time versus bulk density.

-----SIP PLOT-----

of
Harshbarger #5-29
SWNW 29-34N-58E, Sheridan Co. MT

Figure C-45a. Crossplot bulk density versus crossplot porosity.

-----SIP PLOT-----

of
Harshbarger #5-29
SWNW 29-34N-58E, Sheridan Co. MT

Figure C-45b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of
Harshbarger #5-29
SWW 29-34N-58E, Sheridan Co. MT

Figure C-45c. Crossplot interval transit-time versus bulk density.

-----SIP PLOT-----

of
ROSS #11-3
new 3-158N-102M, Williams CO. ND

10-28-1992

19:06:06

Figure C-46a. Crossplot bulk density versus crossplot porosity.

-----SIP PLOT-----

of
 Ross #11-3
 new 3-158N-102H, Williams Co. ND

10-27-1992

17:36:21

Figure C-46b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of
 Ross #11-3
 nesw 3-158N-102W, Williams Co. ND

Figure C-46c. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of
Eddy Mitchell #11-21
nesw 21-158N-102W, Williams Co., ND

Figure C- 47a. Crossplot bulk density versus crossplot porosity.

-----SIP PLOT-----

of
Eddy Mitchell #11-21
nesw 21-158N-102W, Williams Co. ND

18:57:14

10-27-1992

Figure C-47b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of
Eddy Mitchell #11-21
nesw 21-158N-102W, Williams Co. ND

12:01:14

10-30-1992

Figure C-47c. Crossplot interval transit-time versus bulk density.

-----SIP PLOT-----

of
#1 Pasternak #33-13
NWSW 33-158N-102W, Williams Co. ND

10-28-1992

17:09:46

Figure C-48a. Crossplot bulk density versus crossplot porosity.

-----SIP PLOT-----

of
#1 Pasternak #33-13
NWSW 33-158N-102W, Williams Co. ND

Figure C-48b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of
#1 Pasternak #33-13
NWSW 33-158N-102W, Williams Co. ND

Figure C-48c. Crossplot interval transit-time versus bulk density.

-----SIP PLOT-----

of
T.M. Tribal #4-1
SWSE 4-158N-103W, Williams Co. ND

Figure C-49a. Crossplot bulk density versus crossplot porosity.

-----SIP PLOT-----

of
T.M. Tribal #4-1
SWSE 4-158N-103W, Williams Co. ND

10-27-1992

18:01:22

Figure C-49b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of
T.M. Tribal #4-1
swse 4-158N-103W, Williams Co. ND

Figure C-49c. Crossplot interval transit-time versus bulk density.

-----SIP PLOT-----

of
Arco #1 Maebee
sese 30-158N-103W, Williams Co. ND

Figure C-50a. Crossplot bulk density versus crossplot porosity.

-----SIP PLOT-----

Arco #1 Maebec
of
sese 30-158N-103W, Williams Co. ND

Figure C-50b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of
Arco #1 Maebec
sese 30-158N-103W, Williams Co. ND

Figure C-50c. Crossplot interval transit-time versus bulk density.

-----SIP PLOT-----

of
Fischer #34-18
swse 18-159N-102W, Williams Co. ND

Figure C-51a. Crossplot bulk density versus crossplot porosity.

-----SIP PLOT-----

of
Fischer #34-18
swse 18-159N-102W, Williams Co. ND

Figure C-51b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of
Fischer #34-18
SWSE 18-159N-102W, Williams Co. ND

Figure C-51c. Crossplot interval transit-time versus bulk density.

-----SIP PLOT-----

of
Gerald Fischer #1
sene 31-160N-102W, Divide Co., ND

Figure C-52a. Crossplot bulk density versus crossplot porosity.

-----SIP PLOT-----

of
Gerald Fischer #1
sene 31-160N-102W, Divide Co., ND

Figure C-52b. Crossplot interval transit-time versus crossplot porosity.

-----SIP PLOT-----

of
Gerald Fischer #1
sene 31-160N-102W, Divide Co., ND

Figure C-52c. Crossplot interval transit-time versus bulk density.

APPENDIX D

Log-log crossplot of resistivity (R_t) versus porosity (ϕ)
-- (Pickett-Plot) used to determine zone water saturations
in all the wells studied, except the key well. Lines of
constant water saturation (10% - 100%) are shown.

Figure D-1. Crossplot of log Rt versus log Ø for the Anderson #1 well, sene 9-32N-56E.

WELL # 1 Anderson No.1 nmsene 9-32N-56E--> SQUARES
Anderson No.1
Eye fit
M= 2.000 Rm= 0.018

Figure D-17. Crossplot of $\log R_t$ versus $\log \phi$ for the Francis Larson #1 well, new 10-32N-56E.

WELL # 1 Francis Larson #1 new 10-32N-56E---> SQUARES

EYE FIT
M = 2.000

RW = 0.018

Francis Larson #1

Figure D-3. Crossplot of $\log R_t$ versus $\log \phi$ for the N.W. National Life #31-12 well, nwne 12-32N-56E.

WELL # 1 N.W. National Life 31-12 nwne 12-32N-56E--> SQUARES

Eye Fit
M= 2.000 Rm= 0.018

N.W. National Life 31-12

Figure D-4. Crossplot of $\log R_t$ versus $\log \phi$ for the Ator #2 well, nese 21-32N-56E.

WELL # 1 Ator No.2 nese 21-32N-56E--> SQUARES
 Ator No.2 M= 2.000 EYE Fit RM= 0.018

Figure D-5. Crossplot of $\log R_t$ versus $\log \phi$ for the Tronson #1 well, new 27-32N-56E.

WELL # 1 Tronson No. 1 s/2 new 27-32N-56E--> SQUARES
 Eye Fit
 M = 2.000
 RM = 0.018
 Tronson No. 1

Figure D-6. Crossplot of $\log R_t$ versus $\log \phi$ for the FLB Peterson #1 well, sw/4 1-32N-57E.

Figure D-7. Crossplot of $\log R_t$ versus $\log \phi$ for the Marie Stromberg #1-2-4C well, sesw 2-32N-57E.

WELL # 1 Marie Stromberg #1-2-4C n/2 sesw 2-32N-57E--> SQUARES
Eye Fit
M= 2.000 Rm= 0.018
Marie Stromberg #1-2-4C

Figure D-8. Crossplot of $\log R_t$ versus $\log \phi$ for the Fernyhough-Williams #32-7 well, swne 7-32N-57E.

WELL # 1 Fernyhough-Williams #32-7 swne 7-32N-57E--> SQUARES

Eye Fit

M= 2.000 Rm= 0.018

Fernyhough-Williams #32-7

Figure D-9. Crossplot of $\log R_t$ versus $\log \phi$ for the Tronson #1-8 well, swnw 8-32N-57E.

WELL # 1 Tronson No.1-8
 smnw 8-32N-57E--> SQUARES
 Eye fit
 M = 2.000 Rm = 0.018
 Tronson No.1-8

06-15-1992 12:48:26

WELL # 1 Stevens Sweet River 1-10-2B nene 10-32N-57E--> SQUARES
 Stevens Sweet River 1-10-2B Eye fit M= 2.000 Rm= 0.018

Figure D-10. Crossplot of log Rt versus log Ø for the Stevens Sweet River #1-10-2B well, nene 10-32N-57E.

Figure D-11. Crossplot of $\log R_t$ versus $\log \phi$ for the Stromberg #1 well, new 11-32N-57E.

WELL # 1 Stromberg #1 new 11-32N-57E--> SQUARES
Stromberg #1
Eye Fit
M= 2.000
Rw= 0.018

Figure D-12. Crossplot of $\log R_t$ versus $\log \phi$ for the Federal-Stringer #1 well, nwne 14-32N-57E.

WELL # 1 Federal-Stringer No.1 nwne 14-32N-57E--> SQUARES

Federal-Stringer No.1
Eye Fit
M= 2.000
RW= 0.018

Figure D-13. Crossplot of $\log R_t$ versus $\log \phi$ for the Olson #1-20 well, sw/4 20-32N-57E.

WELL # 1 Olson No.1-20 sw/4 20-32N-57E--> SQUARES

Olson No.1-20 Eye Fit M= 2.000 Rm= 0.018

Figure D-14. Crossplot of $\log R_t$ versus $\log \phi$ for the Cartwright #1-25 well, senw 25-32N-57E.

senw 25-32N-57E--> SQUARES

Cartwright No.1-25

WELL # 1

Eye Fit
M= 2.000
RW= 0.018

Cartwright No.1-25

Figure D-16. Crossplot of $\log R_t$ versus $\log \phi$ for the Christensen #1 well, 3-32N-58E.

Well # 1 Christensen No.1
 smw 3-32N-58E--> SQUARES

Christensen No.1
 Eye Fit
 M= 2.000
 Rm= 0.018

Figure D-17. Crossplot of $\log R_t$ versus $\log \phi$ for the NYBY #1-6 well, nese 6-32N-58E.

WELL # 1 NYBY #1-6 nese 6-32N-58E--> SQUARES

NYBY #1-6

M = 2.000

Eye fit

Rm = 0.018

Figure D-18. Eigaspplot of $\log R_t$ versus $\log \phi$ for the Christensen #1 well, sesw 12-32N-58E.

WELL # 1 Christensen No.1 sesw 12-32N-58E---> SQUARES

Eye Fit
M= 2.000
RM= 0.018

Christensen No.1

Figure D-20. Crossplot of $\log R_t$ versus $\log \phi$ for the Willie Bee #2 well, swne 24-32N-58E.

WELL # 1 Willie Bee #2 swne 24-32N-58E--> SQUARES

Willie Bee #2

Eye Fit

M = 2.000

RW = 0.018

Figure D-21. Crossplot of log R_t versus log ϕ for the Union Mortgage #1-29 well, nese 29-32N-58E.

WELL # 1 Union Mortgage No.1-29 nese 29-32N-58E--> SQUARES

Union Mortgage No.1-29 Eye fit M= 2.000 RM= 0.018

Figure D-22. Crossplot of $\log R_t$ versus $\log \phi$ for the Bagaason #1-9 well, sese 9-32N-59E.

WELL # 1 Bagaason 1-9 nmese 9-32N-59E--> SQUARES
 Eye Fit
 M= 2.000 RM= 0.018
 Bagaason 1-9

Figure D-23. Crossplot of $\log R_t$ versus $\log \phi$ for the Maline Eidness #1 well, ssw 6-33N-56E.

WELL # 1 Maline Eidness #1
 ssw 6-33N-56E--> SQUARES

Maline Eidness #1
 Eye Fit
 M= 2.000
 RM= 0.018

Figure D-24. Crossplot of $\log R_t$ versus $\log \phi$ for the Vera Strand #1-21-3C well, seise 21-33N-56E.

Figure D-25. Crossplot of $\log R_t$ versus $\log \phi$ for the Holmgaard #1-27 well, sesw 27-33N-56E.

WELL # 1 Holmgaard No.1-27
sesw 27-33N-56E--> SQUARES

Eye fit
M=2.000
Rm= 0.018
Holmgaard No.1-27

Figure D-26. Crossplot of $\log R_t$ versus $\log \phi$ for the Williams #1-34 well, sesw 34-33N-56E.

WELL # 1 Williams No.1-34
 sesw 34-33N-56E--> SQUARES

Williams No.1-34
 Eye Fit
 M= 2.000
 RM= 0.018

Figure D-27. Crossplot of $\log R_t$ versus $\log \phi$ for the Sun Sundsted #1 well, new 6-33N-57E.

WELL # 1 Sun Sundsted #1 new 6-33N-57E--> SQUARES

Sun Sundsted #1 Eye Fit M= 2.000 Rm= 0.018

Figure D-28. Crossplot of $\log R_t$ versus $\log \phi$ for the Astrup #1 well, swnw 11-33N-57E.

WELL # 1 Astrup No.1 swnw 11-33N-57E--> SQUARES
Astrup No.1 Eye Fit M= 2.000 Rm= 0.018

Figure D-30. Crossplot of log Rt versus log Ø for the Groskurth Petersen #1-21 well, SWNW 21-33N-57E.

WELL # 1 Groskurth Petersen No.1-21 neswnw 21-33N-57E--> SQUARES

Groskurth Petersen No.1-21 Eye Fit M= 2.000 Rm= 0.018

Figure D-31. Crossplot of log Rt versus log Ø for the Patrick-William-Gulf. Miller #2 well, nwse 28-33N-57E.

WELL # 1 Patrick-Williams-Gulf Miller No.2
 5MMSB 28-33N-57E--> SQUARES

Eye Fit
 Patrick-Williams-Gulf Miller No.2
 M = 2.000 RM = 0.018

Figure D-33. Crossplot of $\log R_t$ versus $\log \phi$ for the Clear Lake #1-5 well, NW 5-33N-58E.

WELL # 1 Clear Lake #1-5

Eye Fit
M = 2.000
RM = 0.018

NW 5-33N-58E--> SQUARES

Clear Lake #1-5

Figure D-34. Crossplot of $\log R_t$ versus $\log \phi$ for the Guenther #2-8 well, swne 8-33N-58E.

WELL # 1 Guenther #2-8 swne 8-33N-58E -> SQUARES

Eye Fit
M = 2.000
RM = 0.018

Guenther #2-8

Figure D-35. Crossplot of $\log R_t$ versus $\log \phi$ for the PPC Aminoil #1 Guenther Anderson well, nese 17-33N-58E.

WELL # 1 PPC-Aminoil No.1 Guenther Anderson c n/2 nese 17-33N-58E--> SQUARES

Eye Fit
PPC-Aminoil No.1 Guenther Anderson
M= 2.000 Rm= 0.018

Figure D-36. Crossplot of $\log R_t$ versus $\log \phi$ for the Sampson #1-21 well, nwse 21-33N-58E.

WELL # 1 Sampson 1-21 nwse 21-33N-58E--> SQUARES
 Sampson 1-21
 Eye fit
 M = 2.000
 RM = 0.018

WELL # 1 Arnekleiv No.1 e/2 nw/4 5-34N-56E--> SQUARES
 Arnekleiv No.1
 M= 2.000 Eye Fit
 Rm= 0.018

Figure D-37. Crossplot of log Rt versus log Ø for the Arnekleiv #1 well, nw/4 5-34N-56E.

Figure D-38. Crossplot of $\log R_t$ versus $\log \phi$ for the Josie Larsh #14-1 well, sene 14-34N-56E.

WELL # 1 Josie Larsh No.14-1 sene 14-34N-56E--> SQUARES

Josie Larsh No.14-1
Eye Fit
M= 2.000 Rm= 0.018

Figure D-39. Crossplot of $\log R_t$ versus $\log \phi$ for the Johansen et al #1 well, nwse 25-34N-56E.

WELL # 1 Johansen et al No.1
semwse 25-34N-56E--> SQUARES

Eye Fit
M= 2.000
RM= 0.018

Johansen et al No.1

Figure D-40. Crossplot of $\log R_t$ versus $\log \phi$ for the Nettie Olson #1-28-1B well, new 28-34N-56E.

WELL # 1 Nettie Olson No. 1-28-1B new 28-34N-56E--> SQUARES

Eye Fit
M= 2.000 Rm= 0.018

Nettie Olson No. 1-28-1B

14:57:30

Figure D-41. Crossplot of $\log R_t$ versus $\log \phi$ for the Christianson #1-A well, sesw 15-34N-57E.

WELL # 1 Christianson No.1-A

Eye Fit
M= 2.000
Rw= 0.018

Christianson No.1-A

Figure D-42. Crossplot of $\log R_t$ versus $\log \phi$ for the Christensen #1 well, swnw 22-34N-57E.

WELL # 1 Christensen No. 1
swnw 22-34N-57E--> SQUARES

Christensen No. 1
EYE FIT
M = 2.000
RM = 0.018

Figure D-43. Crossplot of $\log R_t$ versus $\log \phi$ for the Haaven #1-25 well, nw/4 25-34N-58E.

WELL # 1 Haaven #1-25 NW 25-34N-58E--> SQUARES
 Eye Fit
 M= 2.000 RM= 0.018
 Haaven #1-25

WELL # 1 Morken No.1 swne 27-34N-58E--> SQUARES

Morken No.1 M = 2.000 Eye Fil RM = 0.018

Figure D-44. Crossplot of log Rt versus log Ø for the Morken #1 well, swne 27-34N-58E.

Figure D-45. Crossplot of $\log R_t$ versus $\log \phi$ for the Harshbarger #5-29 well, SWNW 29-34N-58E.

WELL # 1 Harshbarger No. 5-29
 Harshbarger No. 5-29
 Eye fit
 M= 2.000
 RM= 0.018
 SWNW 29-34N-58E--> SQUARES

14:03:13

Resistivity

06-15-1992

Figure D-46. Crossplot of $\log R_t$ versus $\log \phi$ for the Ross #11-3 well, new 3-158N-102W.

WELL # 1 Ross No. 11-3 new 3-158N-102W--> SQUARES
 Ross No. 11-3
 Eye Fit
 M = 2.000
 RM = 0.018

Figure D-47. Crossplot of $\log R_t$ versus $\log \phi$ for the Eddy Mitchell #11-21 well, nesw 21-158N-102W.

WELL # 1 Eddy Mitchell 11-21 nesw 21-158N-102W--> SQUARES

Eddy Mitchell 11-21
Eye Fit
M= 2.000 RM= 0.018

Figure D-48. Crossplot of $\log R_t$ versus $\log \phi$ for the #1 Pasternak #33-13 well, nws 33-158N-102W.

WELL # 1 #1 Pasternak #33-13
 nws 33-158N-102W--> SQUARES
 Eye Fit
 H= 2.000
 Rm= 0.018
 #1 Pasternak #33-13

Figure D-49. Crossplot of log Rt versus log Ø for the T.M. Tribal #4-1 well, swse 4-158N-103W.

WELL # 1 T.M. Tribal No.4-1
SWSE 4-158N-103W-- SQUARES

EYE FIT
M=2.000
RM= 0.018
T.M. Tribal No.4-1

Figure D-50. Crossplot of $\log R_t$ versus $\log \phi$ for the Arco #1 Maebee well, sese 30-158N-103W.

WELL # 1 Arco #1 Maebee

Eye Fit
M = 2.000
RM = 0.018

sese 30-158N-103W--> SQUARES

12:10:19

Resistivity

Ø6-15-1992

Figure D-51. Crossplot of $\log R_t$ versus $\log \phi$ for the Fischer #34-18 well, swse 18-159N-102W.

swse 18-159N-102W--> SQUARES

Fischer No.34-18

WELL # 1

Eye Fit
M= 2.000

RW= 0.018

Fischer No.34-18

Figure D-52. Crossplot of $\log R_t$ versus $\log \phi$ for the Gerald Fischer #1 well, 31-160N-102W.

APPENDIX E

Tabulation of results from rock-typing and quantitative formation evaluation in all the wells studied, except the key well.

Table E-1. Combined results of rock-typing and quantitative formation evaluation, Anderson #1, sene 9-32N-56E.

Zone#	Depth	H	ϕ_N	ϕ_D	ϕ_{NC}	Xplot ϕ	Pb	Δt	Δt_c	Code	Rt	CF	Rtc	Swt	DST	Perf.	By-passed OIP(MBO)
1	11110-18	10	-1.0	-10+	0.0	0.0	2.98	51.1	50.0	6Df	16K	0.88	14.1K	1.1K	Yes		
2	11118-25	7	8.0	-2.2	9.0	3.4	2.75	48.7	47.6	4Ab	26	0.88	22.9	82	Yes		
3	11125-30	5	5.6	-4.2	6.6	1.2	2.78	47.1	46.0	4Ab	75	0.88	66.0	137	Yes		
4	11130-34	4	16.6	2.5	17.6	10.1	2.67	54.4	53.3	4Bc	20	0.88	17.6	31	Yes	Yes	
5	11134-38	4	5.4	-8.5	6.4	0.0	2.85	45.8	44.7	5AC	400	0.88	352.0	7.2K	Yes	Yes	
6	11138-40	2	7.8	-4.1	8.8	2.4	2.78	48.0	46.9	4Ac	55	0.88	48.4	80	Yes	Yes	
7	11140-44	4	3.6	-9.5	4.6	0.0	2.86	46.4	45.3	5AC	550	0.88	484.0	6.1K	Yes	Yes	
8	11144-47	3	16.9	3.0	17.9	10.5	2.66	54.2	53.1	4AC	18	0.88	15.8	32	Yes	Yes	
9	11147-52	5	8.2	-6.0	9.2	1.6	2.805	49.8	48.7	4Bd	42	0.88	37.0	137	Yes	Yes	
10	11252-58	6	22.6	7.1	23.6	15.4	2.595	62.2	61.1	5Df	1.7	0.88	1.5	71	Yes	Yes	
11	11158-62	4	1.0	-2.0	2.0	0.0	2.74	50.0	48.9	2Cc	57	0.88	50.2	18.9K	Yes		
12	11162-66	4	1.3	-0.5	2.3	0.9	2.72	50.9	49.8	2Cc	57	0.88	50.2	210	Yes		
13	11166-72	6	0.1	0.0	1.1	0.6	2.71	50.0	48.9	2Cb	190	0.88	167.2	172	Yes		
14	11172-76	4	4.1	-2.0	5.1	1.6	2.75	52.1	51.1	3Dd	10	0.88	8.8	282	Yes		
15	11176-80	4	17.8	2.7	18.8	10.8	2.665	58.0	56.9	5Ce	2.5	0.88	2.2	83	Yes		
16	11180-82	2	10.5	-2.6	11.5	4.5	2.75	53.6	52.5	4Ce	6.1	0.88	5.4	128	Yes		
17	11182-86	4	12.0	0.0	13.0	6.5	2.71	55.4	54.3	4Ce	4.0	0.88	3.5	110	Yes		
18	11186-89	3	2.0	-7.0	3.0	0.0	2.83	49.8	48.7	4Cd	40	0.88	35.2	22.6K	Yes		
19	11189-91	2	5.0	-1.5	6.0	2.3	2.73	53.2	52.1	3Dd	10	0.88	8.8	141	Yes		
20	11191-93	2	1.8	-3.0	2.8	0.0	2.75	50.0	48.9	3Cc	100	0.88	88.0	14.3K	Yes		
21	11193-95	2	1.3	-2.0	2.3	0.2	2.74	49.8	48.7	2Cc	47	0.88	41.4	1.0K	Yes		
22	11195-97	2	0.9	-5.9	1.9	0.0	2.80	49.0	47.9	4Bc	105	0.88	92.4	14.0K	Yes		
23	11197-11200	3	1.4	-1.4	2.4	0.5	2.735	49.7	48.6	2Cb	40	0.88	35.2	452	Yes		
24	11200-07	7	2.9	-4.1	3.9	0.0	2.78	51.7	50.6	3Dd	18	0.88	15.8	33.8K	Yes		
25	11207-09	2	0.2	-5.0	1.2	0.0	2.79	48.0	46.9	3Bc	310	0.88	272.8	8.1K	Yes		
26	11209-11	2	0.8	-0.2	1.8	0.8	2.71	49.3	48.2	2Bb	105	0.88	92.4	174	Yes		
27	11211-13	2	0.8	-2.5	1.8	0.0	2.75	48.8	47.7	3Bb	600	0.88	528.0	5.8K	Yes		
28	11213-16	3	0.9	-1.1	1.9	0.4	2.73	49.4	48.3	2Cb	370	0.88	325.0	186	Yes		
29	11216-20	4	2.0	-5.0	3.0	0.0	2.79	48.0	46.9	3Bc	40	0.88	35.2	22.6K	Yes		
30	11220-22	2	1.2	-8.0	2.2	0.0	2.84	49.0	47.9	4Bd	50	0.88	44.0	20.2K	Yes		
31	11222-24	2	4.9	-4.9	5.9	0.5	2.79	51.8	50.7	3De	9	0.88	7.9	954	Yes		
32	11224-26	2	1.3	-6.3	2.3	0.0	2.815	49.7	48.6	4Cd	250	0.88	220.0	9.0K	Yes		
33	11226-28	2	0.1	-2.0	1.1	0.0	2.74	48.6	47.5	2Bb	250	0.88	220.0	9.0K	Yes		
34	11228-32	4	0.1	-4.0	1.1	0.0	2.78	49.0	47.9	3Bc	390	0.88	343.2	7.2K	Yes		
35	11232-36	4	0.3	-1.1	1.3	0.1	2.725	49.0	47.9	2Bb	160	0.88	140.8	1.1K	Yes		

Table E-2. Combined results of rock-typing and quantitative formation evaluation, Francis Larson #1, new 10-32N-56E.

Zone#	Depth	H	ϕ_N	ϕ_D	ϕ_{NC}	Xplot	Pb	Δt	Δt_c	Code	Rt	CF	Rtc	Swf	DST	Perf.	By-passed OIP(MBO)
1	11170-79	9	-0.9	-10+	0.0	0.0	2.99	50.8	50.0	6Df	44K	0.6	26.0K	832	Yes		
2	11179-82	3	12.3	-3.3	13.2	5.0	2.765	50.0	49.2	5Ac	15	0.6	9.0	89	Yes		
3	11182-84	2	11.8	-5.6	12.7	3.6	2.80	49.2	48.4	5Ad	14	0.6	8.4	128	Yes		
4	11184-86	2	9.4	-2.6	10.3	3.9	2.75	47.7	46.9	4Ab	20	0.6	12.0	99	Yes		
5	11186-88	2	10.9	-2.0	11.8	4.9	2.745	52.7	51.9	4Ac	11	0.6	6.6	106	Yes		
6	11188-91	3	0.7	-4.7	1.6	0.0	2.79	50.0	49.2	3Cd	25	0.6	15.0	34.6K	Yes		
7	11191-94	3	4.4	0.5	5.3	2.9	2.70	53.0	52.2	2Dd	6	0.6	3.6	243	Yes		
8.	11194-97	3	1.0	-3.1	1.9	0.0	2.755	48.0	47.2	3Bb	180	0.6	108.0	12.9K	Yes		
9	11197-99	2	12.0	0.6	12.9	6.8	2.70	51.7	50.9	4Bc	12	0.6	7.2	73	Yes		
10	11199-11201	2	5.0	-3.7	5.9	1.1	2.79	50.2	49.4	4Cd	52	0.6	31.2	218	Yes		
11	11201-03	2	8.2	-0.7	9.1	4.2	2.73	53.0	52.2	4Cd	21	0.6	12.6	89	Yes		
12	11203-05	2	1.6	-6.0	2.5	0.0	2.805	48.0	47.2	4Bc	80	0.6	48.0	19.4K	Yes		
13	11205-08	3	3.1	-1.2	4.0	1.4	2.735	51.7	50.9	3Cd	8	0.6	4.8	437	Yes		
14	11208-09	1	1.4	-4.7	2.3	0.0	2.78	48.0	47.2	3Bc	100	0.6	60.0	17.3K	Yes		
15	11209-12	3	2.0	-4.0	2.9	0.0	2.745	49.9	49.1	3Cd	28	0.6	16.8	32.7K	Yes		
16	11212-17	5	0.3	-2.0	1.2	0.0	2.745	47.8	47.0	2Bb	450	0.6	270.0	8.2K	Yes		
17	11217-19	2	1.1	-4.2	2.0	0.0	2.78	48.5	47.7	3Bc	60	0.6	36.0	22.4K	Yes		
18	11219-22	3	1.2	0.6	2.1	1.4	2.70	52.0	51.2	2Dc	28	0.6	16.8	233	Yes		
19	11222-24	2	1.7	-1.7	2.6	0.5	2.735	52.1	51.3	2Dd	36	0.6	21.6	577	Yes		
20	11224-26	2	3.0	3.0	3.9	3.5	2.66	51.8	51.0	2Cb	30	0.6	18.0	90	Yes		
21	11226-27	1	1.2	-1.4	2.1	0.4	2.735	51.2	50.4	2Dc	42	0.6	25.2	668	Yes		
22	11227-30	3	3.1	2.3	4.0	3.2	2.67	52.2	51.4	2Cb	21	0.6	12.6	118	Yes		
23	11230-34	4	1.2	-2.5	2.1	0.0	2.75	51.0	50.2	3Dd	22	0.6	13.2	36.9K	Yes		
24	11234-39	5	3.2	1.4	4.1	2.8	2.69	52.0	51.2	2Cc	10.5	0.6	6.3	190	Yes		
25	11239-44	5	1.5	-4.8	2.4	0.0	2.79	49.0	48.2	3Cb	72	0.6	43.2	20.4K	Yes		
26	11244-46	2	2.0	-0.1	2.9	1.4	2.71	50.0	49.2	2Cc	49	0.6	29.4	176	Yes		
27	11246-50	4	0.7	-3.9	1.6	0.0	2.77	50.1	49.3	3Cc	260	0.6	156.0	10.7K	Yes		
28	11250-52	2	0.5	0.6	1.4	1.0	2.70	50.6	49.8	2Cb	42	0.6	25.2	267	Yes		
29	11252-57	5	0.9	-2.6	1.8	0.0	2.75	50.0	49.2	3Cc	200	0.6	120.0	12.2K	Yes		
30	11257-61	4	0.3	-1.8	1.2	0.0	2.74	50.0	49.2	2Cc	120	0.6	72.0	15.8K	Yes		
31	11261-64	3	0.0	-5.1	0.9	0.0	2.79	48.2	47.4	3Bc	300	0.6	180.0	10.0K	Yes		
32	11264-70	6	0.6	-2.0	1.5	0.0	2.74	49.9	49.1	2Cc	140	0.6	84.0	4.6K			
33	11270-73	3	0.3	-3.4	1.2	0.0	2.76	48.9	49.3	3Cc	900	0.6	540.0	5.8K			
34	11273-77	4	0.5	0.0	1.4	0.7	2.705	50.1	49.3	2Cb	160	0.6	96.0	195			
35	11277-81	4	0.0	-4.0	0.9	0.0	2.775	48.3	47.5	3Bc	400	0.6	240.0	8.7K			
36	11281-83	2	0.5	-2.0	1.5	0.0	2.745	49.1	48.3	2Cc	110	0.6	66.0	16.5K			
37	11283-85	2	0.4	-3.3	1.3	0.0	2.76	49.7	48.9	3Cc	60	0.6	36.0	22.4K			
38	11285-88	3	1.0	-1.6	1.9	0.2	2.74	49.6	48.8	2Cc	43	0.6	25.8	1.3K			
39	11288-11301	13	0.3	-3.5	1.2	0.0	2.765	49.5	48.7	3Cc	160	0.6	96.0	3.7K			

Table E-3: Combined results of rock-typing and quantitative formation evaluation, N.W. National Life #31-12, mwne 12-32N-56E.

Zone#	Depth	H	ØN	ØD	ØWC	Xplot	Ø	Pb	Δt	Δtc	Code	Rt	CF	Rtc	Swf	DST	Perf.	By-passed OIP(MBO)
1	11356-66	10	-0.8	-10+	0.0	0.0	0.0	2.97	50.3	50.0	6Df	31K	1.0	31K	762	Yes		
2	11366-71	5	11.4	-4.0	12.2	4.1	4.1	2.775	48.9	48.6	4AC	20	1.0	20	73	Yes		
3	11371-77	6	1.5	-8.0	2.3	0.0	0.0	2.84	45.1	44.8	4AC	130	1.0	130	11.8K	Yes		
4	11377-82	5	16.8	2.5	17.6	10.1	10.1	2.665	53.8	53.5	4AB	2.2	1.0	2.2	89	Yes		
5	11382-85	3	2.7	-7.3	3.5	0.0	0.0	2.83	44.0	43.7	4AB	610	1.0	610	5.4K	Yes		
6	11385-87	2	8.4	-1.5	9.2	3.9	3.9	2.73	48.0	47.7	3AB	50	1.02	50	48	Yes		251.7
7	11387-89	2	6.5	-5.2	7.3	1.1	1.1	2.79	48.0	47.7	4BC	102	1.0	102	120	Yes		
8	11389-91	2	6.5	-3.8	7.3	1.8	1.8	2.765	48.0	47.7	3BC	102	1.0	102	73	Yes		
9	11391-93	2	4.8	-4.1	5.6	0.8	0.8	2.775	47.3	47.0	3BC	110	1.0	110	159	Yes		
10	11393-95	2	15.0	2.1	15.8	9.0	9.0	2.67	52.0	51.7	4AC	3	1.0	3	86	Yes		
11	11395-11401	6	7.5	-3.2	8.3	2.6	2.6	2.79	47.2	46.9	4AC	80	1.0	80	57			
12	11401-06	5	20.0	5.8	20.8	13.3	13.3	2.615	56.0	55.7	4Bd	1.7	1.0	1.7	77			
13	11064-18	12	1.4	1.8	2.2	2.0	2.0	2.68	52.0	51.7	2DC	24	1.0	24	136			
14	11418-21	3	6.0	2.2	6.8	4.5	4.5	2.67	50.4	50.1	2Bb	8	1.0	8	105			
15	11421-25	4	8.2	1.0	9.0	5.0	5.0	2.69	53.8	53.5	3Dd	5	1.0	5	120			
16	11425-28	3	19.9	7.0	20.7	13.9	13.9	2.60	58.0	57.7	4Bd	1.9	1.0	1.9	70			
17	11428-29	1	18.7	3.1	19.5	11.3	11.3	2.655	56.8	56.5	5Ce	1.9	1.0	1.9	86			
18	11429-31	2	20.7	6.7	21.5	14.1	14.1	2.60	59.5	59.2	4Ce	1.6	1.0	1.6	75			
19	11431-33	2	13.9	2.7	14.7	8.7	8.7	2.665	58.1	57.8	4Df	2.3	1.0	2.3	101			
20	11433-36	3	16.5	4.7	17.3	11.0	11.0	2.635	60.5	60.2	4Df	2.1	1.0	2.1	84			
21	11436-38	2	5.0	-1.7	5.8	2.1	2.1	2.74	51.1	50.8	3Cd	17	1.0	17	154			
22	11438-42	4	19.8	2.5	20.6	11.6	11.6	2.665	56.1	55.8	5Be	4.3	1.0	4.3	55			
23	11442-45	3	2.9	-0.4	3.7	1.7	1.7	2.72	50.2	49.9	2Cc	43	1.0	43	120			
24	11445-47	2	4.8	2.5	5.6	4.1	4.1	2.67	52.0	51.7	2Cc	30	1.0	30	59			
25	11447-50	3	2.0	0.0	2.8	1.4	1.4	2.705	50.9	50.6	2Cc	40	1.0	40	151			
26	11450-52	2	7.4	2.4	8.2	5.3	5.3	2.67	55.3	55.0	3Dd	5	1.0	5	113			
27	11452-55	3	7.0	-1.0	7.8	3.4	3.4	2.73	53.1	52.8	3Dd	6	1.0	6	161			
28	11455-57	2	4.0	0.0	4.8	2.4	2.4	2.705	51.5	51.2	2Cc	10.4	1.0	10.4	173			
29	11457-59	2	2.0	-2.7	2.8	0.1	0.1	2.75	50.0	49.7	3Cc	85	1.0	85	1.5K			
30	11459-61	2	2.7	-1.0	3.5	1.3	1.3	2.73	50.6	50.3	3Cc	33	1.0	33	179			
31	11461-64	3	0.8	-1.1	1.6	0.3	0.3	2.735	50.2	49.9	2Cc	200	1.0	200	316			
32	11464-67	3	1.8	1.2	2.6	1.9	1.9	2.69	51.6	51.3	2Dc	80	1.0	80	78			
33	11467-70	3	0.8	-3.1	1.6	0.0	0.0	2.76	49.7	49.4	3Cc	150	1.0	150	11.0K			
34	11470-73	3	2.0	-0.1	2.8	1.4	1.4	2.71	51.0	50.7	2Cc	20	1.0	20	214			
35	11473-76	3	1.7	-1.8	2.5	0.4	0.4	2.74	50.3	50.0	2Cc	22	1.0	22	715			
36	11476-78	2	6.7	0.1	7.5	3.8	3.8	2.70	53.0	52.7	3Dd	7	1.0	7	133			
37	11478-80	2	0.9	-1.4	1.7	0.2	0.2	2.73	49.6	49.3	2Cc	48	1.0	48	968			
38	11480-82	2	1.0	-0.3	1.8	0.8	0.8	2.715	50.0	49.7	2Cc	50	1.0	50	237			
39	11482-86	4	0.6	-2.0	1.4	0.0	0.0	2.74	48.8	48.5	3Cc	95	1.0	95	13.8K			

Table E-4: Combined results of rock-typing and quantitative formation evaluation, Ator #2, nese 21-32N-56E.

Zone#	Depth	H	ρ _w	ρ _D	ρ _{Mc}	Xplot	φ	Pb	Δ t	Δ t _c	Code	Rt	CF	Rtc	Swt	DST	Perf.	By-passed OIP(MBO)
1	11296-11304	8	-1.0	-10+	0.0	0.0	0.0	2.99	50.5	50.0	6Df	40K	1.0	40K	670			
2	11304-06	2	5.5	-7.0	6.5	0.0	0.0	2.82	46.1	45.6	4Ac	600	1.0	600	5.5K			
3	11306-11	5	6.4	-5.0	7.4	1.2	2.79	47.2	46.7	4Ac	230	40	1.0	40	176			
4	11311-15	4	1.5	-10+	2.5	0.0	2.89	44.0	43.5	5Ac	40	40	1.0	230	8.8K			
5	11315-18	3	5.6	-4.6	6.6	1.0	2.79	48.0	47.5	4Bc	300	40	1.0	40	212			
6	11318-19	1	1.8	-8.9	2.8	0.0	2.85	44.3	43.8	5Ab	270	1.0	1.0	300	7.7K			
7	11319-21	2	1.8	-7.0	2.8	0.0	2.82	45.6	45.1	4Ab	400	1.0	1.0	270	8.2K			
8	11321-24	3	1.5	-9.0	2.5	0.0	2.855	43.9	43.4	5Ab	140	1.0	1.0	400	6.7K			
9	11324-26	2	4.6	-3.5	5.6	1.1	2.76	46.8	46.3	3Ab	370	1.0	1.0	140	103			
10	11326-29	3	3.6	-6.9	4.6	0.0	2.82	47.2	46.7	4Bc	9	1.0	1.0	370	7.0K			
11	11329-32	3	12.0	-0.6	13.0	6.2	2.72	49.9	49.4	4Ac	80	9	1.0	9	72			
12	11332-34	2	5.7	-7.2	6.7	0.0	2.825	47.0	46.5	4Bc	8	1.0	1.0	80	15.0K			
13	11334-40	6	12.7	-2.0	13.7	5.9	2.75	49.2	48.7	5Ac	60	1.0	1.0	8	80			
14	11340-45	5	0.9	-5.0	1.9	0.0	2.80	48.7	48.2	4Cd	17	1.0	1.0	60	17.3K			
15	11345-47	2	1.5	3.0	2.5	2.8	2.66	52.0	51.5	2Cb	22	1.0	1.0	17	116			
16	11347-48	1	0.9	0.4	1.9	1.2	2.70	51.8	51.3	2Dc	18	1.0	1.0	22	238			
17	11348-50	2	1.4	2.4	2.4	2.4	2.67	52.0	51.5	2Cc	30	1.0	1.0	18	131			
18	11350-56	6	1.1	0.2	2.1	1.2	2.70	51.1	50.6	2Cc	9	1.0	1.0	30	204			
19	11356-58	2	7.2	0.9	8.2	4.6	2.695	53.3	52.8	3Cd	14	1.0	1.0	9	97			
20	11358-61	3	6.0	-0.1	7.0	3.5	2.71	51.7	51.2	3Cc	1.4	1.0	1.0	14	102			
21	11361-63	2	23.5	6.1	24.5	15.3	2.61	58.9	58.4	5Bc	1.9	1.0	1.0	1.4	74			
22	11363-65	2	20.0	5.5	21.0	13.3	2.625	58.1	57.6	5Cc	2.0	1.0	1.0	1.9	73			
23	11365-67	2	21.1	8.0	22.1	15.1	2.535	60.2	59.7	3Cd	1.7	1.0	1.0	2.0	62			
24	11367-68	1	15.2	2.8	16.2	9.5	2.665	58.1	57.6	4Df	1.9	1.0	1.0	1.7	108			
25	11368-71	3	16.5	6.3	17.5	11.9	2.61	58.3	57.8	4Cc	24	1.0	1.0	1.9	81			
26	11371-74	3	2.0	-4.2	3.0	0.0	2.78	48.0	47.5	3Bc	6	1.0	1.0	24	27.4K			
27	11374-79	5	9.0	0.0	10.0	5.0	2.71	54.3	53.8	3De	42	1.0	1.0	6	109			
28	11379-82	3	1.6	-2.0	2.6	0.3	2.74	50.0	49.5	2Cc	20	1.0	1.0	42	690			
29	11382-84	2	3.0	0.0	4.0	2.0	2.71	51.1	50.6	2Cc	30	1.0	1.0	20	149			
30	11384-88	4	1.4	-3.7	2.4	0.0	2.77	50.3	49.8	3Cd	6	1.0	1.0	30	24.4K			
31	11388-91	3	5.0	1.2	6.0	3.6	2.69	53.5	53.0	2Dd	70	1.0	1.0	6	152			
32	11391-95	4	3.0	-3.6	4.0	0.2	2.76	49.6	49.1	3Cc	30	1.0	1.0	70	801			
33	11395-97	2	4.1	-1.8	5.1	1.7	2.735	50.2	49.7	3Cc	105	1.0	1.0	30	144			
34	11397-11400	3	1.8	-2.7	2.8	0.1	2.75	49.0	48.5	3Cc	70	1.0	1.0	105	1.3K			
35	11400-02	2	3.0	0.4	4.0	2.2	2.70	51.1	50.6	2Cc	90	1.0	1.0	70	72			
36	11402-06	4	1.0	-2.2	2.0	0.0	2.745	50.0	49.5	2Cc	8.5	1.0	1.0	90	14.1K			
37	11406-08	2	3.8	-0.1	4.8	2.4	2.71	50.8	50.3	2Cc	8.5	1.0	1.0	8.5	191			
38	11408-10	2	2.8	-3.2	3.8	0.3	2.74	50.7	50.2	2Dc	2.2	1.0	1.0	8.5	1.5K			
39	11410-16	6	12.5	0.9	13.5	7.2	2.70	56.0	55.5	4De	30	1.0	1.0	2.2	125			
40	11416-23	7	1.9	-4.9	2.9	0.0	2.79	50.0	49.5	3Cd	5.8	1.0	1.0	30	24.5K			
41	11423-28	5	6.4	0.5	7.4	4.0	2.70	54.0	53.5	3Dd	6	1.0	1.0	5.8	139			
42	11428-29	1	5.0	-2.0	6.0	2.0	2.75	53.5	53.0	3De	5	1.0	1.0	6	273			
43	11429-30	1	5.0	1.2	6.0	3.6	2.69	53.8	53.3	2Dd	6	1.0	1.0	6	166			
44	11430-32	2	2.9	-2.0	4.9	1.5	2.745	53.0	52.5	3De	4.3	1.0	1.0	5	365			
45	11432-34	2	6.0	0.9	7.0	4.0	2.70	54.0	53.5	3Dd	15	1.0	1.0	6	161			
46	11434-38	4	2.3	-1.4	3.3	1.0	2.735	50.6	50.1	3Cc	4.3	1.0	1.0	4.3	346			

Table E-5: Combined results of rock-typing and quantitative formation evaluation, Tronson #1, new 27-32N-56E.

Zone#	Depth	H	ρ_m	ρ_D	ρ_{sc}	Xplot	ϕ	Pb	Δt	Δt_c	Code	Rt	CP	Rtc	Swa	DST	Perf.	By-passed OIP(MBO)
1	11100-10	10	-1.4	-10+	0.0	0.0	0.0	2.98	50.2	50.0	6Df	50K	0.97	48.5K	609			
2	11110-14	4	7.5	-1.4	8.9	3.8	3.8	2.73	47.5	47.3	3Ab	43	0.97	41.7	54			
3	11114-17	3	2.2	-8.0	3.6	0.0	0.0	2.84	45.5	45.3	4Ac	420	0.97	407.4	6.6K			
4	11117-18	1	4.5	-1.5	5.9	2.2	2.73	50.4	50.2	3Cc	20	0.97	19.4	138				
5	11118-21	3	1.5	-2.9	2.9	0.0	0.0	2.75	50.4	50.2	3Cd	20	0.97	19.4	30.5K			
6	11121-24	3	14.0	2.5	15.4	9.0	2.67	58.0	57.8	4Df	14	0.97	13.5	40				804
7	11124-27	3	3.0	-2.1	4.4	1.2	2.75	50.0	49.8	3Cc	405	0.97	392.6	56				
8	11127-29	2	16.0	3.1	17.4	10.3	2.65	54.9	54.7	4Bd	64	0.97	62.1	16				859
9	11129-31	2	9.8	-1.5	11.2	4.9	2.73	51.9	51.7	4Cd	170	0.97	164.9	21				384
10	11131-33	2	19.0	7.6	20.4	14.0	2.59	57.0	56.8	4Bd	48	0.97	46.6	14				1,196
11	11133-35	2	7.0	-2.8	8.4	2.8	2.75	51.2	51.0	3Cd	200	0.97	194	34				184
12	11135-37	2	13.4	3.2	14.8	9.0	2.66	52.8	52.6	4Bc	60	0.97	58.2	19				724
13	11137-39	2	5.1	-2.2	6.5	2.2	2.75	50.0	49.8	3Cc	102	0.97	98.9	61				
14	11139-41	2	18.9	8.0	20.3	14.2	2.58	58.5	58.3	4Cd	5.1	0.97	5	42				818
15	11141-42	1	15.2	6.8	16.6	11.7	2.60	57.7	57.5	3Cd	5.1	0.97	5	51				
16	11142-45	3	22.0	13.0	23.4	18.2	2.50	62.9	62.7	4De	3.7	0.97	3.6	38				1,401
17	11145-50	5	0.0	0.0	1.4	0.7	2.71	50.4	50.2	2Cc	140	0.97	135.8	164				
18	11150-53	3	-0.1	1.9	1.3	1.6	2.68	50.3	50.1	2Cb	150	0.97	145.5	69				
19	11153-56	3	0.0	-1.0	1.4	0.2	2.73	49.4	49.2	2Cc	190	0.97	184.3	494				
20	11156-63	7	-0.1	1.4	1.3	1.4	2.685	50.3	50.1	2Cb	60	0.97	58.2	125				
21	11163-73	10	-0.3	-3.9	1.1	0.0	2.77	47.7	47.5	3Bc	1.3K	0.97	1.26K	257				
22	11173-78	5	-0.1	-0.9	1.3	0.2	2.725	50.0	49.8	2Cc	700	0.97	679	3.6K				
23	11178-79	1	-0.4	-2.7	1.0	0.0	2.75	47.7	47.5	3Bb	1.4K	0.97	1.36K	227				
24	11179-81	2	-0.4	-0.7	1.0	0.2	2.72	48.0	47.8	2Bb	580	0.97	562.6	282				
25	11181-83	2	-0.4	-3.2	1.0	0.0	2.76	48.0	47.8	3Bc	1.0K	0.97	1.0K	4.2K				
26	11183-86	3	-0.4	-0.4	1.0	0.3	2.72	48.9	48.7	2Cb	400	0.97	388	227				
27	11186-90	4	-0.7	-2.0	0.7	0.0	2.745	48.0	47.8	2Bb	1.6K	0.97	1.55K	3.4K				
28	11190-96	6	-0.7	-3.7	0.7	0.0	2.755	47.9	47.7	3Bb	5.0K4	0.97	4.9K	1.9K				
29	11196-11200	4	-0.4	-0.6	1.0	0.2	2.72	48.9	48.7	2Cb	1.4K	0.97	1.36K	181				
30	11200-05	5	-0.3	-1.0	1.1	0.1	2.73	49.9	49.3	2Cc	9.0K	0.97	8.7K	143				
31	11205-07	2	-0.8	-2.3	0.6	0.0	2.75	48.0	47.8	3Bb	2.9K	0.97	2.8K	2.5K				
32	11207-10	3	-0.8	-0.8	0.6	0.0	2.72	48.0	47.8	2Bb	2.4K	0.97	2.33K	2.8K				
33	11210-15	5	-0.6	-4.5	0.8	0.0	2.785	47.8	47.6	3Bc	600	0.97	582	5.6K				
34	11215-19	4	-0.7	0.0	0.7	0.4	2.71	48.1	47.9	2Bb	600	0.97	582	139				
35	11219-21	2	-0.7	-2.9	0.7	0.0	2.75	48.0	47.8	3Bb	1.0K	0.97	1.0K	4.2K				
36	11221-25	4	-0.7	-0.3	0.7	0.2	2.715	48.1	47.9	2Bb	800	0.97	776	240				
37	11225-27	2	-0.6	-3.2	0.8	0.0	2.76	48.0	47.8	3Bc	680	0.97	659.6	5.2K				
38	11227-30	3	-0.6	-0.8	0.8	0.0	2.725	48.0	47.8	2Bb	500	0.97	485	6.1K				
39	11230-34	4	-0.5	-5.0	0.9	0.2	2.79	47.9	47.7	3Bc	520	0.97	504.4	298				
40	11234-39	5	-0.5	-1.0	0.9	0.0	2.73	48.0	47.8	2Bb	400	0.97	388	6.8K				
41	11239-43	4	-0.5	-4.2	0.9	0.0	2.78	48.1	47.9	3Bc	500	0.97	485	6.1K				
42	11243-47	4	-0.1	-1.6	1.3	0.0	2.73	48.3	48.1	2Cb	210	0.97	203.7	9.4K				
43	11247-53	6	-0.3	-3.2	1.1	0.0	2.76	48.1	47.9	3Bc	270	0.97	261.9	8.3K				
44	11153-56	3	-0.3	-0.3	1.1	0.4	2.715	48.3	48.1	2Cb	200	0.97	194	481				
45	11156-60	4	-0.3	-3.5	1.1	0.0	2.76	48.2	48.0	3Cc	290	0.97	281.3	8.0K				

Table E-6: Combined results of rock-typing and quantitative formation evaluation, FLB Peterson #1, sw/4 1-32N-57E.

Zone#	Depth	H	g _m	g ₀	g _{mc}	Xplot	g _p	Δt	Δt _c	Code	Rt	CP	Rtc	Swt	DST	Perf.	By-passed OIP(MBO)
1	11335-44	9	-1.0	-10+	0.0	0.0	2.99	50.6	50.0	6Df	20K	1.15	23K	884	Yes		
2	11344-50	6	14.0	10.0	15.0	12.5	2.55	51.0	50.4	3Aa	13	1.15	15	27	Yes		2,718
3	11350-55	5	5.5	-8.3	6.5	0.0	2.85	46.0	45.4	5Ac	40	1.15	46	19.8K		Yes	
4	11355-58	3	28.0	16.0	29.0	22.5	2.45	65.0	65.4	4Cc	2.4	1.15	2.8	35		Yes	
5	11358-63	5	38.0	23.0	39.0	31.0	2.34	84.0	83.4	5Df	2.9	1.15	3.3	23		Yes	
6	11363-67	4	4.9	-3.5	5.9	1.2	2.77	50.8	50.2	3Cd	30	1.15	34.5	190		Yes	
7	11367-70	3	20.0	4.6	21.0	12.8	2.635	56.1	55.6	5Bd	8	1.15	9.2	34		Yes	
8	11370-73	3	17.0	0.0	18.0	9.0	2.71	54.0	53.4	5Bd	9	1.15	10.4	46		Yes	
9	11373-76	3	23.8	8.0	24.8	16.4	2.58	57.8	57.2	5Ad	7	1.15	8.1	28		Yes	
10	11376-80	4	1.0	-2.7	2.0	0.0	2.75	50.2	49.6	3Cc	30	1.15	34.5	22.8K		Yes	
11	11380-86	6	13.0	6.3	14.0	10.2	2.60	58.0	57.4	3Dd	3.0	1.15	3.5	70			
12	11386-88	2	2.2	0.3	3.2	1.8	2.70	52.7	52.1	2Dc	19	1.15	21.9	159			
13	11388-91	3	6.0	2.8	7.0	4.9	2.67	54.8	54.2	3Dd	9	1.15	10.4	84			
14	11391-93	2	5.5	0.8	6.5	3.7	2.70	53.8	52.2	3Dd	14	1.15	16.1	90			
15	11393-94	1	5.8	3.9	6.8	5.4	2.65	54.0	53.4	2Cc	9	1.15	10.4	77			
16	11394-95	1	4.8	1.0	5.8	3.4	2.70	54.0	53.4	3Dd	14	1.15	16.4	98			
17	11395-98	3	7.0	3.8	8.0	5.6	2.66	55.0	54.4	3Dd	9	1.15	10.4	74			
18	11398-11401	3	1.1	-2.4	2.1	0.0	2.75	51.0	50.4	3Dd	42	1.15	48.3	19.3K			
19	11401-03	2	12.0	5.0	13.0	9.0	2.625	57.1	56.5	3Dd	3	1.15	3.5	79			
20	11403-08	5	7.5	0.9	8.5	4.7	2.70	54.8	54.2	3De	5	1.15	5.8	118			
21	11408-13	5	22.0	9.0	23.0	16.0	2.585	64.9	64.3	4Df	1.2	1.15	1.4	70			
22	11413-16	3	8.7	-0.2	9.7	4.8	2.715	56.9	56.3	3Df	3.9	1.15	4.5	131			
23	11416-19	3	10.4	2.1	11.4	6.8	2.67	56.0	55.4	3De	3.9	1.15	4.5	93			
24	11419-21	2	3.9	-2.0	4.9	1.5	2.74	51.9	51.3	3Dd	30	1.15	34.5	152			
25	11421-23	2	10.0	3.0	11.0	7.0	2.665	53.7	53.1	3Cc	7	1.15	8.1	67			
26	11423-26	3	2.4	-0.4	3.4	1.5	2.72	52.3	51.7	2Dd	16	1.15	18.4	208			
27	11426-28	2	4.0	2.0	5.0	3.5	2.685	52.9	52.3	2Cc	10	1.15	11.5	113			
28	11428-30	2	4.0	3.4	5.0	4.2	2.65	53.0	52.4	2Cc	10	1.15	11.5	94			
29	11430-33	3	1.5	0.0	2.5	1.3	2.71	51.9	51.3	2Dc	23	1.15	26.5	200			
30	11433-34	4	3.7	1.0	4.7	2.9	2.69	53.4	52.8	2Dd	8	1.15	9.2	152			
31	11434-38	4	2.7	-2.3	3.7	0.7	2.75	52.3	51.7	3Dd	12	1.15	13.8	515			
32	11438-41	3	2.8	2.8	3.8	3.3	2.665	52.8	52.2	2Cc	9.7	1.15	11.2	121			
33	11441-44	3	1.0	-0.4	2.0	0.8	2.72	50.7	50.1	2Cc	85	1.15	97.8	169			
34	11444-47	3	2.0	0.5	3.0	1.8	2.70	50.0	49.4	2Cb	23	1.15	26.5	144			
35	11447-49	2	1.8	-2.0	2.8	0.4	2.74	52.9	52.3	2Dd	100	1.15	115.0	312			
36	11449-52	3	3.0	1.0	4.0	2.5	2.70	53.0	52.4	2Dd	15	1.15	17.3	129			
37	11452-54	2	0.7	-2.8	1.7	0.0	2.75	49.2	48.6	3Cc	110	1.15	126.5	11.9K			
38	11454-55	1	2.8	-0.3	3.8	1.8	2.715	50.1	49.5	2Cb	10	1.15	11.5	219			
39	11455-57	2	2.7	-2.1	3.7	0.8	2.75	51.0	50.4	3Cd	10	1.15	11.5	494			
40	11457-61	4	6.2	1.4	7.2	4.3	2.69	54.3	53.7	3Dd	4	1.15	4.6	145			
41	11461-65	4	1.1	-1.8	2.1	0.2	2.74	50.7	50.1	2Dc	19	1.15	21.9	1.4K			
42	11465-67	2	1.0	0.0	2.0	1.0	2.71	50.9	50.3	2Cc	19	1.15	21.9	286			
43	11467-69	2	0.9	-2.1	1.9	0.0	2.75	50.9	50.3	3Cc	37	1.15	42.6	19.7K			
44	11469-71	2	1.6	-0.1	2.6	1.3	2.715	50.4	49.8	2Cc	14	1.15	16.1	257			
45	11471-73	2	2.0	-1.2	3.0	0.9	2.73	51.0	50.4	2Cc	14	1.15	16.1	371			
46	11473-76	3	3.0	1.1	4.0	2.6	2.69	52.0	51.4	2Cc	9	1.15	10.4	160			
47	11476-81	5	2.0	-4.7	3.0	0.0	2.79	51.7	51.1	3Dc	12	1.15	13.8	36.1K			
48	11481-85	4	4.0	0.8	5.0	2.9	2.70	53.1	52.5	2Dd	5	1.15	5.8	192			
49	11485-87	2	3.0	-0.9	4.0	1.6	2.725	52.3	51.7	3Dd	10	1.15	11.5	247			
50	11487-89	2	3.1	1.3	4.1	2.7	2.69	52.5	51.9	2Dc	9	1.15	10.4	154			
51	11489-91	2	3.9	0.0	4.9	2.5	2.71	52.5	51.9	3Dd	10	1.15	11.5	158			
52	11491-94	3	8.2	2.0	9.2	5.6	2.675	56.0	55.4	3Dc	3.4	1.15	3.9	121			
53	11494-95	1	7.1	0.0	8.1	4.1	2.71	55.0	54.4	3Dc	4	1.15	4.6	152			
54	11495-97	2	7.8	1.6	8.8	5.2	2.68	55.0	54.4	3Dd	4	1.15	4.6	120			
55	11497-11500	3	3.0	-1.5	4.0	1.3	2.73	52.1	51.5	3Dd	9	1.15	10.4	320			

Table E-7: Combined results of rock-typing and quantitative formation evaluation, Marie Stromberg #1-2-4C, sess 2-32B-57E.

Zone#	Depth	H	SW	SD	SWC	Xplot	Pb	Δt	Δtc	Code	Rt	CF	Rtc	Sw	DST	Perf.	By-passed OIP(MBO)
1	11341-50	9	-1.0	-10+	0.0	0.0	3.09	50.5	50.0	6Df	50K	1.0	50K	499			
2	11350-58	8	5.0	-5.5	6.0	0.3	2.0	48.0	47.5	4Bc	33	1.0	33	778			
3	11358-60	2	0.9	-10+	1.9	0.0	2.905	43.5	43.0	6Ac	750	1.0	750	4.9K			
4	11360-70	10	0.8	-8.0	1.8	0.0	2.84	46.6	46.1	4Bc	300	1.0	300	7.7K			
5	11370-72	2	7.5	-4.2	8.5	2.2	2.78	47.8	47.3	4Ac	38	1.0	38	98			
6	11372-76	4	2.8	-8.5	3.8	0.0	2.85	46.2	45.7	5Ac	200	1.02	200	9.5K			
7	11376-77	1	8.7	-3.0	9.7	3.4	2.755	49.5	49.0	4Bc	19	1.0	19	90			
8	11377-82	5	4.7	-7.0	5.7	0.0	2.82	47.7	47.2	4Bc	100	1.0	100	13.4K			
9	11382-87	5	19.5	4.0	20.5	12.3	2.645	56.0	55.5	5Bd	1.8	1.0	1.8	81			
10	11387-89	2	1.5	0.7	2.5	1.6	2.70	51.9	51.4	2Dc	34	1.0	34	143			
11	11389-91	2	2.6	3.9	3.6	3.8	2.65	53.1	52.6	2Cc	20	1.0	20	78			
12	11391-97	6	1.0	-1.0	2.0	0.0	2.72	52.0	51.5	2Dd	44	1.0	44	404			
13	11397-11400	3	2.1	2.0	3.1	2.6	2.67	53.0	52.5	2Dc	23	1.0	23	107			
14	11400-04	4	1.6	-0.4	2.6	1.1	2.72	52.1	51.6	2Dd	30	1.0	30	222			
15	11404-09	5	21.0	6.4	22.0	14.2	2.60	62.1	61.6	4Df	1.8	1.0	1.8	70			
16	11409-11	2	17.7	2.3	18.7	10.5	2.67	56.2	55.7	5Cc	2.4	1.0	2.4	82			
17	11411-13	2	20.5	6.0	21.5	13.8	2.62	58.4	57.9	5Cc	2	1.0	2	68			
18	11413-15	2	19.1	1.5	20.1	10.8	2.69	55.0	54.5	5Bc	2	1.0	2	87			
19	11415-16	1	22.3	4.0	23.3	13.7	2.65	7.5	57.0	5Bc	2	1.0	2	69			
20	11416-17	1	18.2	3.8	19.2	11.5	2.65	7.5	57.0	5Cc	3.2	1.0	3.2	65			
21	11417-20	3	23.0	7.3	24.0	15.7	2.59	1.0	60.5	5Cf	1.5	1.0	1.5	69			
22	11420-23	3	5.0	-3.0	6.0	1.5	2.75	2.0	51.5	3Cd	14	1.0	14	239			
23	11423-26	3	14.1	4.1	15.1	9.6	2.645	7.0	56.5	4Cc	4	1.0	4	69			
24	11426-31	5	2.0	-2.2	2.0	0.0	2.75	1.4	50.9	3Dd	36	1.0	36	22.4K			
25	11431-33	2	3.4	1.9	4.4	3.2	2.68	2.0	51.5	2Cc	25	1.0	25	83			
26	11433-35	2	2.5	-0.9	3.5	1.3	2.725	2.8	52.3	2Dd	31	1.0	31	185			
27	11435-38	3	8.1	2.0	9.1	5.6	2.68	5.0	54.5	3Dd	6	1.0	6	97			
28	11438-41	3	11.0	3.7	12.0	7.9	2.55	7.1	56.6	3Dc	3	1.0	3	98			
29	11441-49	8	1.4	-3.7	2.4	0.0	2.765	-0.0	49.5	3Cc	90	1.0	90	4.1K			
30	11449-52	3	2.3	-0.1	3.3	1.6	2.71	52.2	51.7	2Dc	50	1.0	50	118			
31	11452-56	4	0.8	-3.7	1.8	0.0	2.76	50.7	50.2	3Dd	80	1.0	80	15.0K			
32	11456-60	4	8.9	-0.6	9.9	4.7	2.725	55.4	54.9	4Df	4.3	1.0	4.3	137			
33	11460-63	3	1.0	-3.6	2.0	0.0	2.77	49.6	49.1	3Cc	44	1.0	44	20.2K			
34	11463-70	7	0.0	-1.0	1.0	0.0	2.73	50.0	49.5	2Cc	95	1.0	95	13.8K			
35	11470-74	4	0.5	-4.0	1.5	0.0	2.775	49.0	48.5	3Cc	58	1.0	58	17.6K			
36	11474-79	5	0.5	-1.3	1.5	0.1	2.73	50.0	49.5	2Cc	40	1.0	40	21.2K			
37	11479-82	3	0.6	-6.3	1.6	0.0	2.81	50.0	49.5	4Cd	50	1.0	50	19.0K			
38	11482-84	2	1.1	-2.4	2.1	0.0	2.75	51.0	50.5	3Dd	19	1.0	19	30.8K			
39	11484-86	2	1.0	-4.7	2.0	0.0	2.785	50.1	49.6	3Cd	38	1.0	38	21.8			
40	11486-88	2	1.0	-1.2	2.0	0.4	2.73	50.7	50.2	2Cc	24	1.0	24	684			
41	11488-91	3	1.0	-3.0	2.0	0.0	2.75	50.0	49.5	3Cc	37	1.0	37	22.1K			
42	11491-93	2	1.1	-1.1	2.1	0.5	2.73	50.1	49.6	2Cc	37	1.0	37	441			
43	11493-94	1	1.7	-3.1	2.7	0.0	2.76	51.3	50.8	3Dd	40	1.0	40	21.2K			
44	11494-99	5	2.7	0.0	3.7	1.9	2.72	51.1	50.6	3Cc	20	1.0	20	157			
45	11499-11501	2	1.0	-4.0	2.0	0.0	2.77	50.1	49.6	3Cd	30	1.0	30	24.5K			
46	11501-03	2	1.9	-0.9	2.9	1.0	2.725	51.6	51.1	2Dc	12	1.0	12	387			

Table E-8: Combined results of rock-typing and quantitative formation evaluation, Pernybhough-Williams #32-7, same 7-32K-57E.

Zone#	Depth	H	SW	SD	SWC	Xplot	Pb	Δt	Δt_c	Code	Rt	CF	Rtc	Sw	DST	Perf.	By-passed OIP(MBO)
1	11327-36	9	-1.0	-10+	0.0	0.0	2.97	50.2	50.0	Gdf	40K	1.29	51.6K	590			
2	11336-42	6	15.2	0.0	16.2	8.1	2.71	50.1	49.9	5Ac	17	1.29	21.9	35	Yes	Yes	
3	11342-46	4	11.2	-6.0	12.2	3.1	2.81	48.2	48.0	5Ad	30	1.29	38.7	69	Yes	Yes	
4	11346-50	4	30.0	19.6	31.0	25.3	2.395	79.0	78.8	4Df	2.1	1.29	2.7	32	Yes	Yes	
5	11350-58	8	1.0	-2.0	2.0	0.0	2.74	48.0	47.8	2Bb	220	1.29	283.8	8.0K			
6	11358-63	5	26.0	14.8	27.0	20.9	2.47	64.7	64.5	4Ce	2.5	1.29	3.2	35		Yes	
7	11363-69	6	2.1	-4.5	3.1	0.0	2.79	49.0	48.8	3Cd	62	1.29	80.0	15.0K			
8	11369-74	5	0.2	1.2	1.2	1.2	2.69	50.3	50.1	2Cb	1.4K	1.29	1.8K	26			220?
9	11374-76	2	0.3	-3.0	1.3	0.0	2.75	48.2	48.0	3Cb	150	1.29	193.5	9.6K			
10	11376-81	5	0.1	1.7	1.1	1.4	2.69	50.0	49.8	2Cb	90	1.29	116.1	88			
11	11381-84	3	0.0	0.0	1.0	0.5	2.70	50.0	49.8	2Cb	400	1.29	516.0	118			
12	11384-87	3	0.2	3.1	1.2	2.2	2.66	50.2	50.0	1Cb	80	1.29	103.2	60			
13	11387-90	3	1.0	1.0	2.0	1.5	2.69	50.0	49.8	2Cb	86	1.29	110.9	84			
14	11390-93	3	1.2	2.2	2.2	2.2	2.67	50.2	50.0	2Cb	40	1.29	51.6	84			
15	11393-96	3	1.0	1.0	2.0	1.5	2.695	49.5	48.3	2Cb	64	1.29	82.6	98			
16	11396-98	2	3.0	1.7	4.0	2.9	2.685	51.0	50.8	2Cb	16	1.29	20.6	101			
17	11398-11404	6	0.5	-4.4	1.5	0.0	2.785	48.0	47.8	3Bc	150	1.29	193.5	9.6K			
18	11404-08	4	1.0	0.9	2.0	1.5	2.695	49.8	49.6	2Cb	120	1.29	154.8	71			
19	11408-10	2	1.0	-1.8	2.0	0.1	2.72	49.2	49.0	2Cb	150	1.29	193.5	964			
20	11410-13	3	1.8	0.8	2.8	1.8	2.70	50.8	50.6	2Cc	120	1.29	154.8	59			
21	11413-16	3	0.8	-0.9	1.8	0.5	2.72	49.0	48.8	2Cb	400	1.29	516.0	118			
22	11416-18	2	1.0	1.0	2.0	1.5	2.695	50.0	49.8	2Cb	200	1.29	258.0	55			
23	11418-20	2	0.5	-0.9	1.0	0.3	2.725	49.0	48.8	2Cb	350	1.29	451.5	210			
24	11420-21	1	0.5	1.2	1.5	1.4	2.695	48.4	48.2	2Ba	130	1.29	167.7	74			
25	11421-23	2	0.3	-0.9	1.3	0.2	2.725	48.0	47.8	2Bb	400	1.29	400.0	295			
26	11423-29	6	0.2	0.0	1.2	0.6	2.70	49.8	49.6	2Cb	160	1.29	206.4	155			
27	11429-31	2	0.3	-1.0	1.3	0.2	2.72	48.7	48.5	2Cb	900	1.29	1.1K	196			76
28	11431-32	1	0.7	2.3	1.7	2.0	2.67	51.1	50.9	2Cb	140	1.29	180.6	49			92
29	11432-34	2	1.0	1.0	2.0	1.5	2.69	50.7	50.5	2Cb	410	1.29	528.9	38			
30	11434-37	3	0.8	2.0	1.8	1.9	2.68	51.2	51.0	2Cb	130	1.29	167.7	54			
31	11437-40	3	0.2	-1.0	1.2	0.1	2.73	48.4	48.2	2Cb	350	1.29	451.5	631			
32	11440-43	3	1.5	0.2	2.5	1.4	2.70	48.7	48.5	2Bb	65	1.29	83.9	104			
33	11443-45	2	1.5	-1.9	2.5	0.3	2.74	49.5	49.3	2Cc	65	1.29	83.9	488			
34	11445-47	2	2.8	0.3	3.8	2.1	2.70	50.0	49.8	2Cb	29	1.29	37.4	104			
35	11447-48	1	1.9	-0.3	2.9	1.3	2.715	49.0	48.8	2Bb	75	1.29	96.8	104			
36	11448-50	2	1.2	0.5	2.2	1.4	2.70	49.7	49.5	2Cb	75	1.29	96.8	97			

Table E-9: Combined results of rock-typing and quantitative formation evaluation, Tromson #1-8, snw 8-32N-57E.

Zone#	Depth	H	ϕ_m	ϕ_D	ϕ_{uc}	Xplot ϕ	Pb	Δt	Δt_c	Code	Rt	CP	Rtc	Swt	DST	Perf.	By-passed OIP(MBO)
1	11351-61	10	-0.8	-10+	0.0	0.0	2.98	50.4	50.0	6Df	9K	0.76	6.8K	1.6K	Yes		
2	11361-65	4	11.0	-2.8	11.8	4.5	2.75	47.4	47.0	4Ab	21	0.76	16.0	74	Yes		
3	11365-69	4	9.3	-4.6	10.1	2.8	2.785	47.5	47.1	4Ac	25	0.76	19.0	109	Yes	Yes	
4	11369-75	6	26.5	9.8	27.3	18.6	2.55	63.5	63.1	5Df	2.6	0.76	2.0	51	Yes	Yes	
5	11375-85	10	4.0	-6.0	4.8	0.0	2.80	45.0	44.6	4Ab	300	0.76	228.0	8.9K			
6	11385-90	5	21.0	7.5	21.8	14.7	2.59	56.0	55.6	4Ac	2.7	0.76	2.1	62	Yes		
7	11390-93	3	9.7	-2.5	10.5	4.0	2.75	51.0	50.6	4Bd	15	0.76	11.4	99			
8	11393-98	5	22.0	7.2	22.8	15.0	2.59	57.0	56.6	5Bc	2.7	0.76	2.1	61	Yes		
9	11398-11403	5	3.5	1.1	4.3	2.7	2.69	50.8	50.4	2Cb	60	0.76	45.6	73			
10	11403-05	2	1.1	2.3	1.9	2.1	2.665	51.0	50.6	1Cb	35	0.76	26.6	123			
11	11405-07	2	0.9	0.0	1.7	0.9	2.71	50.5	50.1	2Cc	150	0.76	114.0	139			
12	11407-10	3	1.0	2.3	1.8	2.1	2.67	50.4	50.0	2Cb	47	0.76	35.7	106			
13	11410-12	2	1.2	1.0	2.0	1.5	2.69	50.4	50.0	2Cb	47	0.76	35.7	149			
14	11412-14	2	1.5	3.0	2.3	2.7	2.665	50.6	50.2	1Cb	30	0.76	22.8	104			
HOLE PROBLEM																	
15	11426-28	2	4.8	-3.5	5.6	1.1	2.76	49.9	49.5	3Cc	27	0.76	20.5	269			
16	11428-29	1	5.3	-1.6	6.1	2.3	2.74	50.2	49.8	3Cc	19	0.76	14.4	153			
17	11429-32	3	2.0	-2.0	2.8	0.4	2.745	49.9	49.5	3Cc	170	0.76	129.2	295			
18	11432-36	4	4.0	0.5	4.8	2.7	2.70	51.0	50.6	2Cc	21	0.76	16.0	124			
19	11436-44	8	1.7	-2.1	2.5	0.2	2.74	49.9	49.5	2Cc	100	0.76	76.0	769			
20	11444-46	2	1.0	-0.4	1.8	0.7	2.705	49.0	48.6	2Cb	65	0.76	49.4	272			
21	11446-50	4	0.8	-3.0	1.6	0.0	2.75	48.5	48.1	3Cc	130	0.76	98.8	13.5K			
22	11450-52	2	1.1	-1.5	1.9	0.2	2.73	49.5	49.1	2Cc	110	0.76	83.6	733			
23	11452-55	3	1.0	-4.2	1.8	0.0	2.78	48.3	47.9	3Bc	800	0.76	608.0	5.4K			
24	11455-60	5	2.1	1.6	2.9	2.3	2.69	50.8	50.4	2Cb	120	0.76	91.2	61			

Table E-10: Combined results of rock-typing and quantitative formation evaluation, Stevens Street River #1-10-Zn, zone 10-32N-57E.

Zone#	Depth	Δ	ΔH	ΔH	ΔH	Δt	Δt	Code	Rt	CF	Rtc	Sw	DST	Perf.	By-passed
															OUT(MMO)
1	11389-98	10	-1.0	-104	0.0	0.0	2.38	51.0	50.0	60f	35K	117			
2	11390-11404	6	7.4	-2.1	8.4	3.2	2.75	48.0	47.0	48b	16	104			
3	11404-08	4	4.6	-104	5.6	0.0	2.90	46.9	45.9	52d	22	28.6K			
4	11408-09	1	16.7	2.0	17.7	7.0	2.68	52.7	51.7	58c	2.7	82			
5	11409-10	1	16.7	-3.8	17.7	7.0	2.77	52.7	51.7	58c	3	110			
6	11410-14	4	28.9	9.5	21.0	15.3	2.56	56.1	55.1	48b	3	50			
7	11414-20	6	2.3	-5.0	3.3	0.0	2.79	44.0	43.0	30a	300	7.7K			1,513
8	11420-22	2	11.5	-1.5	12.5	5.5	2.73	51.0	50.0	48c	11	73			
9	11422-24	2	10.0	-2.8	11.0	4.1	2.75	50.9	49.9	48c	14	87			
10	11422-26	2	13.7	0.0	14.7	7.4	2.71	52.0	51.0	48c	6	74			
11	11426-28	2	13.7	-2.5	14.7	6.1	2.75	52.5	51.5	58d	6	89			
12	11428-31	3	16.5	1.9	17.5	9.7	2.68	54.0	53.0	48c	2.4	89			
13	11431-36	5	2.6	-2.7	3.6	0.5	2.75	49.9	48.9	30c	22	572			
14	11436-38	2	12.5	4.0	13.5	8.8	2.65	54.0	53.0	48c	3	80			
15	11438-40	2	1.1	1.1	2.1	1.6	2.695	51.2	50.2	20b	40	132			
16	11440-45	5	2.1	2.5	3.1	2.8	2.67	52.0	51.0	20b	10	151			
17	11445-49	4	1.8	4.0	2.8	3.4	2.65	51.2	50.2	20a	21	86			
18	11449-54	5	2.0	0.0	3.0	1.5	2.71	52.0	51.0	20c	15	230			
19	11454-60	6	24.0	12.0	25.0	18.5	2.52	69.0	68.0	40f	0.7	86			
20	11460-61	3	18.5	3.2	19.5	11.4	2.66	55.0	54.0	58d	2.5	74			
21	11463-67	4	24.7	6.8	25.7	16.3	2.60	59.0	58.0	58d	1.5	67			
22	11467-69	2	19.9	4.8	20.9	12.9	2.63	58.0	57.0	58c	1.8	77			
23	11469-72	3	26.1	5.5	27.1	16.3	2.62	64.1	63.1	68f	1.8	82			
24	11472-75	3	10.5	2.5	11.5	7.0	2.67	55.6	54.6	30a	4.1	94			
25	11475-78	3	18.7	8.0	19.7	13.9	2.58	62.0	61.0	48f	1.3	84			
26	11478-81	3	4.2	-4.0	5.2	0.6	2.78	51.9	50.9	30c	20	500			
27	11481-83	2	8.0	1.6	9.0	5.3	2.685	52.9	51.9	30c	8	89			
28	11483-85	2	6.0	-0.6	7.0	3.2	2.725	51.9	50.9	30c	19	96			
29	11485-87	2	13.5	4.9	14.5	9.7	2.63	56.3	55.3	30a	3	79			
30	11487-89	2	13.5	2.3	14.5	8.4	2.67	56.3	55.3	40c	3	92			
31	11489-92	3	18.9	6.5	19.9	13.2	2.61	61.5	60.5	40f	1.5	82			
32	11492-97	5	2.0	-2.0	3.0	0.5	2.74	51.7	50.7	20d	30	489			
33	11497-98	1	8.2	-0.5	9.2	4.4	2.72	52.5	51.5	30a	7	115			
34	11498-501	3	2.3	-1.4	3.3	3.3	2.74	50.0	49.0	30c	21	134			
35	11501-04	3	5.4	1.1	6.4	3.0	2.69	52.5	51.5	30c	21	77			
36	11504-06	2	3.8	-3.2	4.8	0.8	2.76	51.8	50.8	30d	30	136			
37	11506-11	5	22.0	11.4	23.0	17.2	2.525	64.6	63.6	40b	0.9	82			
38	11511-13	2	17.0	1.8	18.0	9.9	2.68	55.0	54.0	50d	2.2	91			
39	11513-16	3	18.9	3.7	19.9	11.8	2.65	59.5	58.5	58f	1.4	96			
40	11516-24	8	5.2	-2.4	6.2	1.9	2.75	52.0	51.0	30a	10	223			
41	11524-32	8	16.7	6.0	17.7	11.9	2.61	59.7	58.7	40a	1.8	84			
42	11532-34	2	17.0	-0.1	18.0	4.0	2.70	53.0	52.0	30c	6	136			
43	11534-36	2	12.0	0.0	13.0	6.5	2.785	56.3	55.3	40a	2.8	123			
44	11536-38	2	4.6	-4.0	5.6	0.8	2.78	51.4	50.4	30a	10.6	515			
45	11538-40	2	9.5	0.2	10.5	6.3	2.70	56.0	55.0	40a	3.3	117			
46	11540-42	2	9.5	-2.0	10.5	4.3	2.74	56.0	55.0	40f	3.3	171			
47	11542-44	2	11.1	2.1	12.1	7.1	2.67	56.3	55.3	30a	3.3	100			
48	11544-48	4	10.0	1.1	11.0	6.1	2.70	55.9	54.9	40a	4	109			
49	11548-50	2	15.5	3.6	16.5	10.1	2.65	59.1	58.1	40f	1.7	101			
50	11550-51	1	13.4	2.0	14.4	8.2	2.68	57.5	56.5	40f	2.1	112			
51	11551-53	2	15.2	2.6	16.2	9.4	2.67	58.0	57.0	40f	1.6	112			
52	11553-54	1	9.4	2.0	10.4	6.2	2.68	54.5	53.5	30d	4.5	102			
53	11554-56	2	10.5	4.6	11.5	8.1	2.64	56.0	55.0	30d	3.0	95			
54	11556-57	1	6.3	-2.0	7.3	2.7	2.74	54.2	53.2	30a	5.0	222			
55	11557-59	2	7.5	1.4	8.5	5.0	2.69	54.9	53.9	30d	3.5	143			
56	11559-60	1	5.2	1.6	6.2	3.9	2.685	54.0	53.0	20d	5	153			
57	11560-62	2	4.4	-2.0	5.4	1.7	2.745	53.0	52.0	30c	5.5	336			
58	11562-64	2	4.4	1.3	5.4	3.4	2.69	53.3	52.3	20c	5.5	168			
59	11564-66	2	4.7	0.7	5.7	3.2	2.70	52.8	51.8	30c	10	385			
60	11566-68	2	4.7	0.7	5.7	3.2	2.70	52.8	51.8	30c	8	148			
61	11568-69	1	3.5	-3.7	4.5	0.4	2.77	51.0	50.0	30a	14	896			
62	11569-71	2	3.9	0.0	4.9	2.5	2.71	51.0	50.0	30c	13	140			
63	11571-72	1	3.0	-2.0	4.0	1.0	2.76	51.0	50.0	30a	16	335			
64	11572-74	2	3.7	0.0	4.7	2.4	2.71	51.0	50.0	20c	15	144			
65	11574-76	2	2.6	-3.0	3.6	0.3	2.76	50.9	49.9	30d	19	1.8K			

Table E-11: Combined results of rock-typing and quantitative formation evaluation, Stromberg #1, new 11-32N-57E.

Zone#	Depth	H	PN	PD	PHC	Xplot	Pb	/ t	tc	Code	Rt	CP	Rtc	Sw4	DST	Perf.	By-passed OIP(MBO)
1	11299-11308	9	-1.3	-10+	0.0	0.0	3.00	50.6	50.0	60f	24K	1.0	24K	866	Yes		
2	11308-113	5	10.2	-3.5	11.5	4.0	2.76	49.7	49.1	48c	52	1.0	52	14	Yes		
3	11313-16	3	4.9	-7.5	6.2	0.0	2.83	46.1	45.5	48c	54	1.0	52	18.5K	Yes		
4	11316-21	5	24.8	10.6	26.1	18.4	2.54	62.6	62.0	50f	5	1.0	5	32	Yes	Yes	
5	11321-24	3	22.9	7.9	23.5	13.7	2.59	60.0	59.4	50f	12	1.0	12	24	Yes	Yes	
6	11324-27	3	30.0	13.8	31.3	22.6	2.49	68.0	67.4	50f	9.6	1.0	9.6	19	Yes	Yes	
7	11327-32	5	15.0	200	16.3	9.2	2.67	54.0	53.4	48d	27	1.0	27	28	Yes	Yes	
8	11332-36	4	22.8	8.0	24.1	16.1	2.58	60.4	59.8	50e	8	1.0	8	29	Yes	Yes	
9	11336-38	2	12.4	1.9	13.7	7.8	2.68	55.0	54.4	40d	22	1.0	22	36	Yes	Yes	496
10	11338-40	2	18.5	4.5	19.8	12.2	2.63	56.0	55.4	40d	16	1.0	16	27	Yes	Yes	884
11	11340-41	1	9.0	-1.2	10.3	4.6	2.73	53.0	52.4	48d	22	1.0	16	27	Yes	Yes	
12	11341-43	2	9.9	2.8	11.2	7.0	2.67	55.3	54.7	30d	6	1.0	27	56	Yes	Yes	
13	11343-45	2	0.0	-2.9	1.3	0.0	2.75	50.0	49.4	30c	41	1.0	6	78	Yes	Yes	
14	11345-47	2	3.4	0.8	4.7	2.8	2.70	52.2	51.6	30c	41	1.0	41	21.0K	Yes	Yes	
15	11347-50	3	0.6	-0.6	1.9	0.7	2.72	51.5	50.9	20c	12	1.0	12	138	Yes	Yes	
16	11350-57	7	0.7	2.0	2.0	2.0	2.68	53.0	52.4	20c	28	1.0	28	362	Yes	Yes	
17	11357-59	2	0.0	-1.3	1.3	0.0	2.73	51.0	50.4	20c	16	1.0	16	167	Yes	Yes	
18	11359-62	3	0.8	2.4	2.1	2.3	2.67	52.0	51.4	20c	44	1.0	44	20.2K	Yes	Yes	
19	11362-63	1	0.0	-2.0	1.3	0.0	2.74	50.4	49.8	20c	50	1.0	22	124	Yes	Yes	
20	11363-65	2	2.2	1.7	3.5	2.6	2.68	53.5	52.9	20c	50	1.0	50	19.0K	Yes	Yes	
21	11365-67	2	2.0	-1.9	3.3	0.7	2.74	53.0	52.4	20d	11	1.0	11	155	Yes	Yes	
22	11367-70	3	1.5	0.9	2.8	1.9	2.70	52.0	51.4	20c	14	1.0	14	512	Yes	Yes	
23	11370-74	4	9.5	3.4	10.8	7.1	2.65	57.0	56.4	30c	12	1.0	12	203	Yes	Yes	
24	11374-79	5	2.0	-2.0	3.3	0.7	2.74	51.0	50.4	30c	2.8	1.0	14	512	Yes	Yes	
25	11379-81	2	2.6	0.7	3.9	2.3	2.70	52.0	51.4	20c	9	1.0	9	194	Yes	Yes	
26	11381-84	3	4.6	-4.2	1.7	0.0	2.78	50.0	49.4	30d	42	1.0	42	20.7K	Yes	Yes	
27	11384-88	4	4.6	1.0	5.9	3.5	2.69	50.0	49.4	30d	8	1.0	8	135	Yes	Yes	
28	11388-91	3	0.8	-2.0	2.1	0.1	2.74	51.5	50.9	20d	41	1.0	41	2.1K	Yes	Yes	
29	11391-94	3	2.9	0.1	4.2	2.7	2.70	52.5	51.9	20c	10	1.0	10	192	Yes	Yes	
30	11394-97	3	1.0	-3.2	2.2	2.0	2.76	50.3	49.7	30c	27	1.0	27	25.8K	Yes	Yes	
31	11397-99	2	2.8	-0.5	4.1	1.8	2.72	52.8	52.2	20d	7	1.0	7	281	Yes	Yes	
32	11399-11401	2	2.8	-2.2	4.1	1.8	2.75	52.8	52.2	20d	7	1.0	7	507	Yes	Yes	
33	11401-03	2	6.1	-1.0	7.4	3.2	2.72	55.0	54.4	30c	5	1.0	5	187	Yes	Yes	
34	11403-10	7	1.0	-5.0	7.4	3.2	2.79	50.4	49.8	30d	70	1.0	70	16.7K	Yes	Yes	
35	11410-12	2	1.4	-3.1	2.7	0.0	2.79	50.4	49.8	30d	24	1.0	24	136	Yes	Yes	
36	11412-15	3	1.7	-0.3	4.3	2.0	2.71	53.0	52.4	20d	40	1.0	40	21.2K	Yes	Yes	
37	11415-17	2	13.6	2.6	14.9	8.8	2.69	59.5	58.9	40f	1.9	1.0	1.9	110	Yes	Yes	
38	11417-20	3	13.3	1.0	14.6	7.8	2.69	59.5	58.9	40f	2	1.0	2	121	Yes	Yes	
39	11420-24	4	15.5	4.0	16.8	10.4	2.65	60.1	59.5	40f	1.4	1.0	1.4	109	Yes	Yes	
40	11424-26	2	1.8	-3.2	3.1	0.0	2.76	50.0	49.4	30c	20	1.0	20	30.0K	Yes	Yes	
41	11426-29	3	2.0	-2.0	3.3	0.7	2.74	51.5	50.9	30d	18	1.0	18	451	Yes	Yes	
42	11429-31	2	1.4	-3.1	2.7	0.0	2.76	50.2	49.6	30c	23	1.0	23	28.0K	Yes	Yes	
43	11431-33	2	6.0	1.0	7.3	4.2	2.70	55.7	55.1	30f	4	1.0	4	159	Yes	Yes	
44	11433-35	2	9.0	-1.5	7.3	2.9	2.63	55.7	55.1	30f	4	1.0	4	231	Yes	Yes	
45	11435-38	3	9.1	1.1	10.4	5.8	2.69	57.0	56.4	30f	3	1.0	3	133	Yes	Yes	
46	11438-40	2	8.8	-4.2	10.1	3.0	2.78	56.0	55.4	40f	4.1	1.0	4.1	220	Yes	Yes	
47	11440-42	2	8.8	-1.2	10.1	4.5	2.73	56.0	55.4	40f	3.6	1.0	3.6	157	Yes	Yes	
48	11442-43	1	3.5	-3.0	4.8	0.9	2.76	52.3	51.7	30d	8.5	1.0	8.5	511	Yes	Yes	
49	11443-45	2	7.8	-1.5	9.1	3.8	2.73	55.0	54.4	30d	4.1	1.0	4.1	174	Yes	Yes	
50	11445-48	3	3.5	-3.7	4.8	0.6	2.77	51.7	51.1	30d	10	1.0	10	707	Yes	Yes	
51	11448-52	4	8.0	0.4	9.3	4.9	2.70	55.6	55.0	30d	5	1.0	5	122	Yes	Yes	
52	11452-55	3	7.0	-2.0	8.3	3.2	2.74	54.7	54.1	30d	5.1	1.0	5.1	185	Yes	Yes	
53	11455-57	2	17.0	6.0	18.3	12.2	2.61	61.4	60.8	40f	1.8	1.0	1.8	81	Yes	Yes	
54	11457-58	1	13.0	3.0	14.3	8.7	2.66	59.7	59.1	40f	2	1.0	2	109	Yes	Yes	
55	11458-60	2	14.0	5.8	15.3	10.6	2.62	60.0	59.4	40f	2	1.0	2	89	Yes	Yes	
56	11460-63	3	10.8	1.1	12.1	6.6	2.69	57.8	57.2	40f	3.1	1.0	3.1	115	Yes	Yes	
57	11463-66	3	12.7	4.2	14.0	9.1	2.64	59.2	48.6	30d	2.5	1.0	2.5	93	Yes	Yes	
58	11466-68	2	6.0	-1.8	7.3	2.8	2.74	55.0	54.4	30d	4.3	1.0	4.3	231	Yes	Yes	
59	11468-70	2	7.0	0.0	8.3	4.2	2.71	55.0	54.4	30d	4	1.0	4	159	Yes	Yes	
60	11470-72	2	5.7	-1.4	7.0	2.8	2.73	52.2	51.6	30c	9	1.0	9	121	Yes	Yes	
61	11472-74	2	5.7	0.8	7.0	3.9	2.70	52.2	51.6	30c	8	1.0	8	121	Yes	Yes	
62	11474-75	1	2.5	-2.9	3.8	0.5	2.75	52.1	51.5	20d	9	1.0	9	894	Yes	Yes	
63	11475-77	2	2.5	-1.3	3.8	1.3	2.73	52.0	51.4	30d	9	1.0	9	344	Yes	Yes	
64	11477-78	1	1.2	-4.0	2.5	0.0	2.77	50.9	50.3	30d	21	1.0	21	29.3K	Yes	Yes	
65	11478-80	2	1.0	-0.5	2.3	0.9	2.72	50.7	50.1	20c	15	1.0	15	384	Yes	Yes	
66	11480-82	2	0.8	-3.2	2.1	0.0	2.76	50.6	50.0	30d	25	1.0	25	26.8K	Yes	Yes	
67	11482-86	4	0.7	-1.0	2.0	0.5	2.72	50.8	50.2	20c	20	1.0	20	599	Yes	Yes	
68	11486-88	2	1.0	-3.3	2.3	0.0	2.76	50.2	49.6	30d	22	1.0	22	28.6K	Yes	Yes	
69	11488-89	1	0.8	-1.0	2.1	0.6	2.73	50.4	49.8	20c	20	1.0	20	500	Yes	Yes	
70	11489-92	3	0.9	-2.6	2.2	0.0	2.70	51.0	50.4	20c	20	1.0	20	30.0K	Yes	Yes	
71	11492-94	2	1.1	0.0	2.4	1.2	2.71	52.0	51.4	20c	11	1.0	10.5	345	Yes	Yes	
72	11494-96	4	1.2	-3.7	2.5	0.0	2.77	51.9	51.3	30d	11	1.0	11	40.1	Yes	Yes	
73	11496-98	2	1.6	0.6	2.9	1.8	2.70	52.0	51.4	20c	10	1.0	10	235	Yes	Yes	
74	11498-11503	5	1.6	-3.0	2.9	0.0	2.75	51.7	51.1	30d	12	1.0	12	38.7K	Yes	Yes	
75	11503-05	2	2.8	0.5	4.1	2.3	2.70	52.0	51.4	20c	10	1.0	10	164	Yes	Yes	
76	11505-07	2	1.0	-5.0	2.3	0.0	2.79	51.4	50.8	30d	17	1.0	17	32.5K	Yes	Yes	

Table E-12: Combined results of rock-typing and quantitative formation evaluation, Federal-Stringer #1, nwn 14-32N-57E.

Zone#	Depth	H	βW	βD	βMc	Xplot	ρ	Pb	Δt	Δtc	Code	Rt	CF	Rtc	Swk	DST	Perf.	By-passed OIP(MBO)
1	11241-50	9	-0.7	-10+	0.0	0.0	0.0	2.96	50.0	50.0	60f	50K	1.0	50K	599			
2	11250-55	5	8.8	-3.1	9.5	3.2	2.76	45.8	45.8	45.8	4Ab	300	1.0	300	24			604
3	11255-60	5	0.1	-10+	0.8	0.0	2.87	43.0	43.0	43.0	5Ac	3.0K	1.0	3.0K	2.4K			1,789
4	11260-64	4	18.0	2.4	18.7	10.6	2.67	52.0	52.0	52.0	5Ac	65	1.0	65	15			
5	11264-68	4	1.5	-8.0	2.2	0.0	2.84	44.0	44.0	44.0	4Ab	2.8K	1.0	2.8K	2.5K			
6	11268-71	3	8.4	2.5	9.1	5.8	2.65	48.0	48.0	48.0	2Ba	140	1.0	140	19			700
7	11271-73	2	8.5	-3.3	9.1	2.9	2.76	48.0	48.0	48.0	4Bc	300	1.0	300	26			213
8	11273-75	2	17.4	1.1	18.1	9.6	2.69	53.5	53.5	53.5	5Bd	44	1.0	44	21			753
9	11275-76	1	6.9	-2.7	7.6	2.5	2.75	50.5	50.5	50.5	3Cd	199	1.0	190	38			77
10	11276-78	2	10.4	0.1	11.1	5.6	2.705	51.0	51.0	51.0	3Bc	49	1.0	49	34			367
11	11278-80	2	5.0	-5.5	5.7	0.1	2.80	46.8	46.8	46.8	4Bc	390	1.0	390	679			
12	11280-84	4	1.3	-1.0	2.0	0.0	2.725	48.6	48.6	48.6	2Cb	62	1.0	62	340			
13	11284-87	3	0.1	-2.7	0.8	0.0	2.75	47.6	47.6	47.6	3Bb	1.0K	1.0	1.0K	4.2K			
14	11287-90	3	0.0	0.7	0.7	0.7	2.70	48.0	48.0	48.0	2Ba	2.3K	1.0	2.3K	39			
15	11290-92	2	0.0	2.0	0.7	1.4	2.675	47.9	47.9	47.9	1Ba	4.0K	1.0	4.0K	15			64?
16	11292-11300	8	0.0	1.0	0.7	0.9	2.70	48.1	48.1	48.1	2Bb	30K	1.0	30K	15			118?
17	11300-02	2	0.0	2.1	0.7	1.4	2.67	48.0	48.0	48.0	1Ba	18K	1.0	18K	7			129?
18	11302-08	6	0.0	-2.6	0.7	0.0	2.75	47.9	47.9	47.9	3Bb	4.2K	1.0	4.2K	2.1K			
19	11308-10	2	7.0	-4.0	7.7	3.9	2.70	52.0	52.0	52.0	3Cc	11	1.0	11	103			
20	11310-13	3	2.0	-4.0	2.7	0.0	2.77	47.2	47.2	47.2	3Bb	170	1.0	170	10.3K			
21	11313-16	3	4.5	-1.7	5.2	1.8	2.74	48.0	48.0	48.0	3Bb	41	1.0	41	116			
22	11316-18	2	2.0	-2.4	2.7	0.2	2.75	47.6	47.6	47.6	3Bb	510	1.0	510	297			
23	11318-20	2	11.2	-0.9	11.9	5.5	2.725	52.1	52.1	52.1	4Cd	25	1.0	25	98			284
24	11320-23	3	1.0	-2.5	1.7	0.0	2.75	47.5	47.5	47.5	3Bb	200	1.0	200	9.5K			
25	11323-25	2	0.2	-3.3	0.9	0.0	2.76	47.0	47.0	47.0	3Bb	5.2K	1.0	5.2K	1.5K			
26	11325-27	2	0.6	-1.1	1.3	0.0	2.73	48.7	48.7	48.7	2Cb	2.4K	1.0	2.4K	2.3K			
27	11327-30	3	0.2	-3.6	0.9	0.0	2.765	47.0	47.0	47.0	3Bb	5.0K	1.0	5.0K	1.5K			
28	11330-35	5	0.1	-5.0	0.8	0.0	2.79	46.6	46.6	46.6	3Bc	800	1.0	800	4.7K			
29	11335-39	4	0.7	-2.3	1.4	3.0	2.745	48.6	48.6	48.6	2Cc	650	1.0	650	5.3K			
30	11339-42	3	0.8	0.8	1.5	1.2	2.70	50.1	50.1	50.1	2Cb	2.0K	1.0	2.0K	25			134?
31	11342-44	2	0.7	-1.1	1.4	0.2	2.73	48.1	48.1	48.1	2Cb	36K	1.0	36K	35			13?
32	11344-45	1	0.7	2.3	1.0	1.0	2.74	47.2	47.2	47.2	2Bb	36K	1.0	36K	3			137?
33	11345-48	3	0.3	-2.0	1.0	0.0	2.79	47.0	47.0	47.0	3Bc	36K	1.0	36K	707			
34	11348-53	5	0.2	-5.0	0.9	0.0	2.79	47.0	47.0	47.0	3Bc	8.0K	1.0	8.0K	1.5K			
35	11353-57	4	0.1	-2.0	0.8	0.0	2.745	47.0	47.0	47.0	2Bb	2.5K	1.0	2.5K	2.7K			
36	11357-63	6	0.2	-4.2	0.9	0.0	2.78	47.1	47.1	47.1	3Bc	3.0K	1.0	3.0K	2.4K			
37	11363-69	6	3.0	-2.7	3.7	0.5	2.75	50.3	50.3	50.3	3Cd	70	1.0	70	320			
38	11369-71	2	1.6	-5.1	2.3	0.0	2.80	48.0	48.0	48.0	4Cc	130	1.0	130	11.8K			
39	11371-75	4	1.0	-1.8	1.7	0.0	2.74	48.5	48.5	48.5	2Cb	95	1.0	95	13.8K			
40	11375-77	2	0.8	-5.5	1.5	0.0	2.80	47.4	47.4	47.4	4Bc	300	1.0	300	7.7K			
41	11377-81	4	0.3	-2.7	1.0	0.0	2.75	47.3	47.3	47.3	3Bb	1.0K	1.0	1.0K	4.2K			
42	11381-83	2	0.2	-4.3	0.9	0.0	2.78	47.5	47.5	47.5	3Bc	1.7K	1.0	1.7K	3.3K			
43	11383-87	4	0.1	-3.0	0.8	0.0	2.75	47.4	47.4	47.4	3Bb	2.1K	1.0	2.1K	4.0K			
44	11387-91	4	0.0	-1.4	0.7	0.0	2.735	47.6	47.6	47.6	2Bb	5.0K	1.0	5.0K	2.9K			
45	11391-93	2	0.0	-3.1	0.7	0.0	2.76	47.7	47.7	47.7	3Bc	5.0K	1.0	5.0K	1.9K			
46	11393-95	2	0.0	-0.7	0.7	0.0	2.72	47.8	47.8	47.8	2Bb	5.0K	1.0	5.0K	1.5K			
47	11395-11400	5	0.0	-2.0	0.7	0.0	2.75	47.7	47.7	47.7	2Bb	40K	1.0	40K	671			
48	11400-04	4	0.0	-0.9	0.7	0.0	2.725	47.7	47.7	47.7	2Bb	31K	1.0	31K	762			
49	11404-06	2	0.0	-2.4	0.7	0.0	2.75	47.7	47.7	47.7	2Bb	45K	1.0	45K	632			
50	11406-08	2	0.0	0.0	0.7	0.4	2.70	47.7	47.7	47.7	2Bb	39K	1.0	39K	16			334?
51	11408-11	3	0.0	-1.8	0.7	0.0	2.735	47.7	47.7	47.7	2Bb	41K	1.0	41K	662			
52	11411-13	2	0.0	0.0	0.7	0.4	2.71	47.7	47.7	47.7	2Bb	30K	1.0	30K	19			32?
53	11413-14	1	0.0	-1.8	0.7	0.0	2.73	47.9	47.9	47.9	2Bb	14K	1.0	14K	1.1K			
54	11414-16	2	0.0	-1.5	0.7	0.1	2.72	47.9	47.9	47.9	2Bb	15K	1.0	15K	109			
55	11416-19	3	0.0	-2.0	0.7	0.0	2.74	47.7	47.7	47.7	2Bb	11K	1.0	11K	1.3K			
56	11419-21	2	0.0	-0.8	0.7	0.0	2.72	47.7	47.7	47.7	2Bb	10K	1.0	10K	1.3K			
57	11421-24	3	0.0	-3.1	0.7	0.0	2.755	47.7	47.7	47.7	3Bb	6.5K	1.0	6.5K	1.7K			
58	11424-26	2	0.0	-1.9	0.7	0.0	2.74	47.7	47.7	47.7	2Bb	4.1K	1.0	4.1K	2.1K			
59	11426-29	3	0.0	0.0	0.7	0.4	2.76	47.4	47.4	47.4	3Bb	6.0K	1.0	6.0K	43			34?
60	11429-33	4	0.0	-3.5	0.7	0.0	2.71	47.8	47.8	47.8	2Bb	2.0K	1.0	2.0K	3.0K			
61	11433-37	4	0.0	-4.2	0.7	0.0	2.785	47.4	47.4	47.4	3Bc	7.0K	1.0	7.0K	1.6K			
62	11437-42	5	0.0	-1.8	0.7	0.0	2.74	47.3	47.3	47.3	2Bb	3.4K	1.0	3.4K	2.3K			
63	11442-44	2	0.0	-4.8	0.7	0.0	2.775	47.2	47.2	47.2	3Bc	6.0K	1.0	6.0K	1.7K			

Table E-13: Combined results of rock-typing and quantitative formation evaluation, Olson #1-20, SW/4 20-32N-57E.

Zone#	Depth	H	ØN	ØD	ØNC	Xplot	Ø	Pb	Δt	Δtc	Code	Rt	CF	Rtc	Swt	DST	Perf.	By-passed OIP(MBO)
1	11309-18	9	-1.0	-10+	0.0	0.0	0.0	2.98	50.0	50.0	6Df	650	0.9	585	5.5K			
2	11318-24	6	5.0	-4.0	6.0	1.0	1.0	2.77	47.0	47.0	3Bb	130	0.9	117	124	Yes	Yes	
3	11324-28	4	1.8	-9.4	2.8	0.0	0.0	2.86	43.5	43.5	5Ac	500	0.9	450	6.3K	Yes	Yes	
4	11328-30	2	9.3	-2.8	10.3	3.8	0.0	2.75	49.0	49.0	4Bc	30	0.9	27	67	Yes	Yes	
5	11330-36	6	0.9	-1.0	1.9	0.0	0.0	2.87	43.0	43.0	5Ac	400	0.9	360	7.1K	Yes		
6	11336-40	4	3.3	-5.8	4.3	0.0	0.0	2.81	46.0	46.0	4Ac	340	0.9	306	7.7K	Yes		
7	11340-42	2	1.1	-7.9	2.1	0.0	0.0	2.85	44.6	44.6	4Ac	340	0.9	306	7.7K	Yes		
8	11342-45	3	16.6	3.1	17.6	7.3	2.66	53.0	53.0	3Bc	70	0.9	63	23	Yes	Yes		
9	11345-50	5	3.1	-7.8	4.1	0.0	0.0	2.84	46.0	46.0	4Ac	300	0.9	270	8.2k	Yes	Yes	
10	11350-54	4	19.7	5.9	20.7	13.3	2.62	55.5	55.5	5Bd	4.0	0.9	3.6	53	Yes	Yes		
11	11354-57	3	-0.1	-1.8	0.9	0.0	0.0	2.74	48.7	48.7	2Cc	300	0.9	270	8.2K	Yes		
12	11357-60	3	0.1	1.2	1.1	1.2	2.69	49.5	49.5	2Cb	240	0.9	216	76	Yes	Yes		
13	11360-63	3	0.0	-1.0	1.0	0.0	0.0	2.725	48.8	48.8	2Cb	300	0.9	270	8.2K	Yes		
14	11363-66	3	0.0	0.0	1.0	0.0	0.5	2.70	49.0	49.0	2Cb	250	0.9	225	178	Yes		
15	11366-70	4	0.5	-2.0	1.5	0.0	0.0	2.74	48.2	48.2	2Cb	280	0.9	252	8.5	Yes	Yes	
16	11370-72	2	4.2	0.0	5.2	2.6	2.705	51.0	51.0	2Cc	21	0.9	18.9	118	Yes	Yes		
17	11372-73	1	1.8	0.2	2.8	1.5	2.70	50.0	50.0	2Cb	32	0.9	28.8	104	Yes	Yes		
18	11373-75	2	4.2	-1.7	5.2	1.8	2.735	51.0	51.0	3Cd	15	0.9	14.5	202	Yes	Yes		
19	11375-78	3	10.0	0.0	11.0	5.5	2.71	53.6	53.6	4Cd	7	0.9	6.3	97				
20	11378-83	5	1.0	-4.3	2.0	0.0	0.0	2.78	47.8	47.8	3Bc	120	0.9	108	12.9K			
21	11383-85	2	1.3	-0.6	2.3	0.9	2.72	49.8	49.8	2Cc	200	0.9	180	111	Yes	Yes		
22	11385-87	2	0.5	-3.0	1.5	0.0	0.0	2.755	47.5	47.5	3Bb	370	0.9	333	7.4K	Yes		
23	11387-89	2	1.0	-1.1	2.0	0.5	2.73	50.0	50.0	2Cc	340	0.9	306	153	Yes			
24	11389-90	1	0.8	-2.2	1.8	0.0	0.0	2.75	48.3	48.3	3Cc	400	0.9	360	7.1K	Yes		
25	11390-91	1	1.0	-1.1	2.0	0.5	2.73	50.6	50.6	2Dc	300	0.9	270	163	Yes			
26	11391-93	2	0.5	-3.0	1.5	0.0	0.0	2.755	48.0	48.0	3Cc	420	0.9	378	6.9K	Yes		
27	11393-95	2	0.3	-1.0	1.3	0.2	2.725	48.2	48.2	2Cb	280	0.9	252	422	Yes	Yes		
28	11395-11401	6	0.1	-4.0	1.1	0.0	0.0	2.775	47.3	47.3	3Bc	440	0.9	396	6.7K	Yes		
29	11401-08	7	0.3	-2.1	1.3	0.0	0.0	2.75	48.2	48.2	3Cc	530	0.9	477	6.1K	Yes		
30	11408-15	7	0.6	0.0	1.6	0.8	2.71	48.9	48.9	2Cc	600	0.9	540	72	Yes	Yes		
31	11415-18	3	0.1	-3.5	1.1	0.0	0.0	2.76	47.7	47.7	3Bc	600	0.9	540	5.8K	Yes		
32	11418-23	5	1.2	-4.8	2.2	0.0	0.0	2.785	48.0	48.0	3Cc	59	0.9	53.1	18.4K	Yes		
33	11423-31	8	0.1	-2.4	1.1	0.0	0.0	2.75	47.8	47.8	3Bd	550	0.9	495	6.0K	Yes		
34	11431-38	7	0.3	-4.0	1.3	0.0	0.0	2.775	48.0	48.0	3Cc	200	0.9	180	10.0K	Yes		
35	11438-42	4	0.5	-0.9	1.5	0.3	2.72	48.4	48.4	2Cb	70	0.9	63	563	Yes	Yes		
36	11442-44	2	0.3	-3.0	1.3	0.0	0.0	2.755	48.0	48.0	3Cc	150	0.9	135	11.5K	Yes		
37	11444-46	2	0.4	-2.2	1.4	0.0	0.0	2.75	48.1	48.1	3Cc	120	0.9	108	12.9K	Yes		
38	11446-50	4	0.8	-6.6	1.8	0.0	0.0	2.815	48.0	48.0	4Cd	160	0.9	144	11.2K	Yes		
39	11450-52	2	1.0	-1.9	2.0	0.1	2.74	49.4	49.4	2Cc	29	0.9	26.1	2.6K				
40	11452-54	2	1.7	-3.8	2.7	0.0	0.0	2.77	49.2	49.2	2Cc	31	0.9	27.9	25.4K			
41	11454-57	3	1.5	-2.0	2.5	0.3	2.75	49.4	49.4	3Cc	24	0.9	21.6	962				
42	11457-62	5	1.4	-3.8	2.4	0.0	0.0	2.76	48.7	48.7	3Cc	60	0.9	54	18.3K			
43	11462-65	3	1.0	0.1	2.0	1.5	2.705	49.7	49.7	2Cb	42	0.9	37.8	145				
44	11465-70	5	0.2	-3.1	1.2	0.0	0.0	2.76	48.0	48.0	3Cc	230	0.9	207	9.3K			
45	11470-72	2	0.3	-2.2	1.3	0.0	0.0	2.75	48.0	48.0	3Cb	200	0.9	180	10.0K			
46	11472-76	4	0.1	-4.0	1.1	0.0	0.0	2.77	48.0	48.0	3Cc	300	0.9	270	8.2K			
47	11476-78	2	0.1	-1.0	1.1	0.1	2.72	48.0	48.0	2Bb	250	0.9	225	894				
48	11478-82	4	0.2	-3.1	1.2	0.0	0.0	2.76	48.0	48.0	3Cc	210	0.9	189	9.8K			
49	11482-88	6	0.5	-2.8	1.5	0.0	0.0	2.75	48.0	48.0	3Cb	120	0.9	108	12.9K			
50	11488-90	2	0.9	-4.2	1.9	0.0	0.0	2.78	74.9	74.9	3Bc	170	0.9	153	10.8K			

Table E-14: Combined results of rock-typing and quantitative formation evaluation, Cartwright #1-25, semw 25-32N-57E.

Zone#	Depth	H	ØN	ØD	ØNC	Xplot	Ø	Pb	Δt	Δtc	Code	Rt	CF	Rtc	Swt	DST	Perf.	By-passed OIP(MBO)
1	11473-82	9	-1.0	-10+	0.0	0.0	2.99	50.4	50.0	6Df	10K	1.0	1.0	10K	1.3K	Yes		
2	11482-88	6	8.3	-3.4	9.3	3.0	2.76	48.0	47.6	4Ac	18	1.0	1.0	18	105	Yes		
3	11488-92	4	1.0	-10+	2.0	0.0	2.88	44.0	43.6	5Ac	170	1.0	1.0	170	10.3K	Yes		
4	11492-96	4	20.7	5.7	21.7	13.7	2.62	55.7	55.3	5Ac	1.4	1.0	1.0	1.4	82	Yes		
5	11496-11502	6	1.9	-10+	2.9	0.0	2.91	44.0	43.6	6Ad	440	1.0	1.0	440	6.4K	Yes		
6	11502-06	4	18.7	3.8	19.7	11.8	2.65	53.6	53.2	5Ac	3	1.0	1.0	3	65	Yes		
7	11506-08	2	17.2	-2.6	18.2	7.8	2.75	53.3	52.9	5Be	4	1.0	1.0	4	86	Yes		
8	11508-12	4	5.8	-6.5	6.8	0.2	2.81	52.0	51.6	4Df	8	1.0	1.0	8	2.4K	Yes		
9	11512-14	2	9.2	-2.5	10.2	3.9	2.75	54.3	53.9	4Df	6	1.0	1.0	6	140	Yes		
10	11514-16	2	5.9	2.3	6.9	4.6	2.67	51.5	51.5	2Bb	6	1.0	1.0	6	119	Yes		
11	11516-18	2	22.0	8.1	23.0	15.6	2.585	61.5	61.1	5Df	1	1.0	1.0	1	86	Yes		
12	11518-20	2	20.9	2.3	21.9	12.1	2.67	58.0	57.6	5Cf	1.8	1.0	1.0	1.8	82	Yes		
13	11520-22	2	21.7	8.0	22.7	15.4	2.58	62.7	62.3	4Df	1.1	1.0	1.0	1.1	83	Yes		
14	11522-24	2	6.0	1.0	7.0	4.0	2.69	53.9	53.5	3Dd	7	1.0	1.0	7	126	Yes		
15	11524-26	2	6.0	2.9	7.0	5.0	2.665	54.8	54.4	2Dd	6.2	1.0	1.0	6.2	107	Yes		
16	11526-27	1	4.9	0.0	5.9	3.0	2.71	54.0	53.6	3Dd	10	1.0	1.0	10	141	Yes		
17	11527-29	2	6.1	2.0	7.1	4.6	2.775	53.0	52.6	5Ce	10	1.0	1.0	10	92	Yes		
18	11529-34	5	2.0	0.6	3.0	1.8	2.70	51.8	51.4	2Dc	50	1.0	1.0	50	105	Yes		
19	11534-39	5	24.1	11.2	25.1	18.2	2.525	66.8	66.4	4Df	1	1.0	1.0	1	73	Yes		
20	11539-41	2	20.0	4.1	21.0	12.6	2.65	58.5	58.1	5Cf	1.7	1.0	1.0	1.7	81	Yes		
21	11541-43	2	21.0	6.0	22.0	14.0	2.62	58.5	58.1	5Ce	1.7	1.0	1.0	1.7	73	Yes		
22	11543-45	2	19.9	4.3	20.9	12.6	2.64	57.1	56.7	5Be	1.7	1.0	1.0	1.7	81	Yes		
23	11545-48	3	25.4	9.0	26.4	17.7	2.565	63.8	63.4	5Df	1.1	1.0	1.0	1.1	72	Yes		
24	11548-51	3	18.7	0.6	19.7	10.2	2.70	58.0	57.6	5Df	1.9	1.0	1.0	1.9	95	Yes		
25	11551-54	3	24.1	8.9	25.1	17.0	2.57	65.1	64.7	5Df	1	1.0	1.0	1	78	Yes		
26	11554-58	4	10.3	-1.7	11.3	4.8	2.735	55.0	54.6	4Df	6	1.0	1.0	6	114	Yes		
27	11558-61	3	20.0	5.2	21.0	13.1	2.625	61.5	61.1	5Df	3	1.0	1.0	3	59	Yes		
28	11561-64	3	6.0	-1.0	7.0	3.0	2.725	53.0	52.6	3Dd	10	1.0	1.0	10	141	Yes		
29	11564-67	3	13.0	3.8	14.0	8.9	2.65	59.0	58.6	4Df	3	1.0	1.0	3	87	Yes		
30	11567-71	4	11.9	2.0	12.9	7.5	2.68	58.5	58.1	4Df	3.3	1.0	1.0	3.3	98	Yes		
31	11571-76	5	22.7	9.1	23.7	16.4	2.56	64.4	64.0	4Df	1	1.0	1.0	1	81	Yes		
32	11576-80	4	2.0	-3.1	3.0	0.0	2.76	50.9	50.5	3Dd	33	1.0	1.0	33	23.5K	Yes		
33	11580-83	3	9.8	0.2	10.8	6.4	2.70	54.0	53.6	4Cd	9	1.0	1.0	9	69	Yes		
34	11583-85	2	3.4	-2.0	4.4	1.2	2.74	51.0	50.6	3Cd	40	1.0	1.0	40	176	Yes		
35	11585-88	3	6.0	0.4	7.0	3.7	2.70	53.6	53.2	3Dd	28	1.0	1.0	28	68	Yes		
36	11588-97	4	1.1	-3.5	2.1	0.0	2.76	50.8	50.4	3Dd	46	1.0	1.0	46	19.8K	Yes		
37	11592-99	3	4.0	-0.4	5.0	2.3	2.715	51.7	51.3	3Dc	6.5	1.0	1.0	6.5	228	Yes		
38	11595-97	2	2.9	-3.2	3.9	0.4	2.76	51.2	50.8	3Dd	10.5	1.0	1.0	10.5	1.0K	Yes		
39	11597-99	2	4.7	0.0	5.7	2.9	2.71	52.8	52.4	3Dd	5.8	1.0	1.0	5.8	192	Yes		
40	11599-11605	6	0.6	-1.4	1.6	0.1	2.735	49.9	49.5	2Cc	30	1.0	1.0	30	2.4K	Yes		
41	11605-10	5	0.6	-4.0	1.6	0.0	2.775	48.5	48.1	3Cc	60	1.0	1.0	60	17.3K	Yes		
42	11610-12	2	1.7	-0.1	2.7	1.3	2.72	50.6	50.2	2Cc	14	1.0	1.0	14	275	Yes		
43	11612-14	2	1.1	-3.3	2.1	0.0	2.76	50.0	49.6	3Cc	21	1.0	1.0	21	29.3K	Yes		
44	11614-18	4	1.8	-2.0	2.8	0.4	2.74	50.0	49.6	2Cc	14	1.0	1.0	14	896	Yes		
45	11618-21	3	1.5	-3.4	2.5	0.0	2.765	51.7	51.3	3Dd	24	1.0	1.0	24	27.4K	Yes		
46	11621-23	2	1.7	-1.8	2.7	0.5	2.74	51.7	51.3	2Dd	17	1.0	1.0	17	650	Yes		

Table E-15: Combined results of rock-typing and quantitative formation evaluation, Siggard #1, mwne 2-32N-58E.

Zone#	Depth	H	ØN	ØD	ØNC	Xplot	Ø	Pb	Δt	Δtc	Code	Rt	CF	Rtc	Sw%	DST	Perf.	By-passed OIP(MBO)
1	11380-89	9	-0.8	-10+	0.0	0.0	0.0	2.97	50.0	50.0	6Df	50K	1.0	50K	599	Yes		
2	11389-90	1	11.0	-3.0	11.8	4.4	4.4	2.705	48.0	48.0	3Ab	140	1.0	140	25	Yes		246
3	11390-93	3	2.3	-6.5	3.1	0.0	0.0	2.81	45.3	45.3	3Ab	205	1.0	205	9.4K	Yes		
4	11393-97	4	12.0	0.4	12.8	6.6	6.6	2.70	54.0	54.0	4Cd	15	1.0	15	52	Yes		
5	11397-11400	3	37.1	31.1	37.9	34.5	34.5	2.00	63.0	63.0	Omit	3.4	1.0	3.4	21	Yes	Yes	
6	11400-04	4	22.0	10.0	22.8	16.4	16.4	2.55	58.8	58.8	4Bd	6.1	1.0	6.1	33	Yes	Yes	
7	11404-07	3	29.0	17.6	29.8	23.7	23.7	2.425	62.9	62.9	4Bc	5	1.0	5	25	Yes	Yes	
8	11407-10	3	4.0	-2.3	4.8	1.3	1.3	2.75	48.0	48.0	3Bb	54	1.0	54	140			
9	11410-13	3	16.7	2.3	17.5	9.9	9.9	2.665	52.3	52.3	4Ac	18	1.0	18	33			988
10	11413-17	4	0.1	-3.2	0.9	0.0	0.0	2.76	47.6	47.6	3Bb	110	1.0	110	12.8K			
11	11417-20	3	1.6	-0.4	2.4	1.0	1.0	2.72	49.6	49.6	2Cc	50	1.0	50	189			
12	11420-22	2	0.0	-1.0	0.8	0.0	0.0	2.73	48.5	48.5	2Cb	90	1.0	90	14.1K			
13	11422-24	2	0.8	0.0	1.6	0.8	0.8	2.71	48.5	48.5	2Bb	60	1.0	60	216			
14	11424-27	3	0.5	-2.3	1.3	0.0	0.0	2.75	48.0	48.0	3Bb	300	1.0	300	7.7K			
15	11427-30	3	0.7	0.7	1.5	1.1	1.1	2.70	49.0	49.0	2Cb	200	1.0	200	86			
16	11430-32	2	0.0	0.0	0.8	0.4	0.4	2.715	48.7	48.7	2Cb	250	1.0	250	212			
17	11432-36	4	0.2	0.5	1.0	0.8	0.8	2.70	48.9	48.9	2Cb	170	1.0	170	128			
18	11436-38	2	0.0	-0.3	0.8	0.3	0.3	2.72	48.9	48.9	2Cb	330	1.0	330	246			
19	11438-42	4	0.1	1.4	0.9	1.2	1.2	2.69	49.7	49.7	2Cb	110	1.0	110	106			
20	11442-47	5	0.0	-2.0	0.8	0.0	0.0	2.74	49.0	49.0	2Cb	500	1.0	500	6.0K			
21	11447-49	2	1.1	-0.6	1.9	0.7	0.7	2.72	49.5	49.5	2Cc	57	1.0	57	253			
22	11449-51	2	0.5	-1.4	1.3	0.0	0.0	2.73	48.0	48.0	2Bb	110	1.0	110	12.8K			
23	11451-55	4	2.0	-2.6	2.8	0.1	0.1	2.75	48.7	48.6	3Cc	30	1.0	30	2.4K			
24	11455-62	7	0.1	-4.0	0.9	0.0	0.0	2.775	47.7	47.7	3Bc	1.2K	1.0	1.2K	3.9K			
25	11462-64	2	0.4	-0.1	1.2	0.6	0.6	2.71	51.0	51.0	2Dc	240	1.0	240	144			
26	11464-66	2	0.1	-2.0	0.9	0.0	0.0	2.74	47.6	47.6	2Bb	800	1.0	800	4.7K			
27	11466-69	3	0.9	-3.5	1.7	0.6	0.6	2.72	50.4	50.4	2Dc	500	1.0	500	100			
28	11469-71	2	4.8	2.6	5.6	4.1	4.1	2.63	55.4	55.4	1Dd	180	1.0	180	25			232
29	11471-73	2	0.8	-1.9	1.6	0.0	0.0	2.74	48.5	48.5	2Cc	600	1.0	600	5.5K			
30	11473-76	3	0.4	-1.0	1.2	0.1	0.1	2.725	50.3	50.3	2Dc	300	1.0	300	774			
31	11476-84	8	0.0	-4.0	0.8	0.0	0.0	2.77	46.7	46.7	3Bb	500	1.0	500	6.0K			

Table E-16: Combined results of rock-typing and quantitative formation evaluation, Christensen #1, swne 3-32N-58E.

Zone#	Depth	H	φN	φD	φMc	Xplot	φ	Pb	Δt	Δtc	Code	Rt	CF	Rtc	Swt	DST	Perf.	By-passed OIP(MBO)
1	11390-11400	10	-1.0	-10+	0.0	0.0	0.0	2.95	50.4	50.0	6Df	28K	0.65	18.2K	994			
2	11400-05	5	10.0	-1.0	11.0	5.0	5.0	2.73	47.0	46.6	4Aa	20	0.65	13.0	74			
3	11405-09	4	4.8	-6.9	5.8	0.0	0.0	2.82	46.0	45.6	4Ac	55	0.65	35.8	22.4K			
4	11409-18	9	24.0	9.5	25.0	17.3	2.56	58.8	58.4	5Bd	2.1	0.65	1.4	65				
5	11418-25	7	13.1	0.0	14.1	7.1	2.71	50.7	50.3	4Ac	11	0.65	7.2	70				
6	11425-30	5	31.0	17.6	32.0	24.8	2.43	68.0	67.6	5Df	1.4	0.65	0.9	57		Yes		
7	11430-33	3	12.7	1.5	13.7	7.6	2.69	55.1	54.7	4Ce	4.3	0.65	2.8	105		Yes		
8	11433-36	3	19	5.8	20.0	12.9	2.62	54.8	54.4	4Ac	2.9	0.65	1.9	75		Yes		
9	11436-39	3	10.5	-0.4	11.5	5.6	2.715	51.7	51.3	4Bc	16	0.65	10.4	74		Yes		
10	11439-41	2	4.0	2.1	5.0	3.6	2.67	52.8	52.4	2Cc	13	0.65	8.5	127		Yes		
11	11441-44	3	1.5	0.0	2.5	1.3	2.715	51.2	50.8	2Cc	26	0.65	16.9	251		Yes		
12	11444-46	2	2.0	2.0	3.0	2.5	2.68	51.8	51.4	2Cc	18	0.65	11.7	156		Yes		
13	11446-49	3	0.9	1.2	1.9	1.6	2.695	58.8	50.4	2Cb	38	0.65	24.7	168		Yes		
14	11449-50	1	1.6	5.0	2.6	3.8	2.63	51.7	51.3	1Cb	27	0.65	17.6	84		Yes		
15	11450-53	3	4.0	3.0	5.0	4.0	2.66	53.0	52.6	2Cc	13	0.65	8.5	115		Yes		
16	11453-56	3	3.2	0.0	4.2	2.1	2.71	52.4	52.0	2Dd	43	0.65	28.0	120		Yes		
17	11456-61	5	24.0	8.9	25.0	17.0	2.57	63.0	62.6	5Df	1.6	0.65	1.0	78		Yes		
18	11461-64	3	12.0	5.4	13.0	9.2	2.62	57.2	56.8	3Dd	3.2	0.65	2.1	100		Yes		
19	11464-68	4	25.2	9.1	26.2	17.7	2.56	63.8	63.4	5Df	1.5	0.65	1.0	75		Yes		
20	11468-72	4	4.3	-5.0	5.3	0.2	2.79	50.0	49.6	3Cd	20	0.65	13.0	1.9K		Yes		
21	11472-74	2	7.0	2.0	8.0	5.0	2.67	53.0	52.6	3Cc	12	0.65	7.8	96		Yes		
22	11474-77	3	2.0	0.0	3.0	1.5	2.71	52.0	51.6	2Dc	100	0.65	65.0	110		Yes		
23	11477-79	2	6.0	3.2	7.0	5.2	2.66	55.4	55.0	2Dd	24	0.65	15.6	65		Yes		
24	11479-80	1	2.9	1.6	3.9	2.8	2.68	52.9	52.5	2Dc	150	0.65	97.5	48		Yes		
25	11480-82	2	4.0	4.5	5.0	4.8	2.64	56.0	55.6	2Dd	60	0.65	39.0	44		Yes		
26	11482-85	3	1.8	-1.5	2.8	0.7	2.73	50.8	50.4	2Cc	90	0.65	58.5	250		Yes		
27	11485-89	4	5.0	1.3	6.0	3.7	2.695	52.0	51.6	3Cc	13	0.65	8.5	124		Yes		
28	11489-91	2	3.0	-1.1	4.0	1.5	2.73	51.8	51.4	3Dd	16	0.65	10.4	277		Yes		
29	11491-95	4	4.2	1.3	5.2	3.3	2.69	52.0	51.6	2Cc	12	0.65	7.8	145		Yes		
30	11495-99	4	1.0	-2.0	2.0	0.0	2.74	50.5	50.1	2Dc	160	0.65	104.0	13.2K		Yes		
31	11499-11500	1	2.0	0.0	3.0	1.5	2.71	49.9	49.5	2Cb	36	0.65	23.4	184		Yes		
32	11500-01	1	1.2	0.0	3.0	1.5	2.71	50.0	49.5	2Cb	36	0.65	58.5	159		Yes		
33	11501-04	3	2.3	1.7	3.3	2.5	2.68	55.0	54.6	2Dd	50	0.65	32.5	94		Yes		
34	11504-06	2	5.0	4.0	6.0	5.0	2.65	56.4	56.0	2Dd	26	0.65	16.9	65		Yes		
35	11506-07	1	2.3	0.1	3.3	1.7	2.705	50.0	49.6	2Cb	60	0.65	39.0	126		Yes		
36	11507-09	2	4.7	1.0	5.7	3.4	2.695	50.0	49.6	3Bb	12	0.65	7.8	141		Yes		
37	11509-11	2	2.0	0.0	3.0	1.5	2.715	50.2	49.8	2Cc	16	0.65	10.4	277		Yes		
38	11511-15	4	3.1	1.2	4.1	2.7	2.695	51.0	50.6	2Cc	11	0.65	7.2	185		Yes		
39	11515-22	7	0.7	-0.6	1.7	0.6	2.72	49.5	49.1	2Cb	58	0.65	37.7	364		Yes		
40	11522-25	3	0.9	2.1	1.9	2.0	2.67	50.0	49.6	2Cb	34	0.65	22.1	142		Yes		
41	11525-28	3	0.9	-1.0	1.9	0.5	2.725	49.5	49.1	2Cb	35	0.65	22.8	561		Yes		
42	11528-30	2	1.0	0.9	2.0	1.5	2.69	50.0	49.6	2Cb	21	0.65	13.7	241		Yes		
43	11530-31	1	0.9	-0.5	1.9	0.7	2.72	49.6	49.2	2Cb	31	0.65	20.2	426		Yes		
44	11531-33	2	1.6	1.3	2.6	2.0	2.69	50.1	49.7	2Cb	20	0.65	13.0	186		Yes		
45	11533-35	2	1.5	-0.5	2.5	1.0	2.72	50.1	49.7	2Cc	25	0.65	16.3	332		Yes		
46	11535-42	7	1.8	1.1	2.8	2.0	2.70	51.7	51.3	2Cc	17	0.65	11.1	201		Yes		
47	11542-47	5	1.0	0.0	2.0	1.0	2.705	49.9	49.5	2Cb	33	0.65	21.5	192		Yes		

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Table E-17: Combined results of rock-typing and quantitative formation evaluation, NYBY #1-6, nese 6-12N-58E.

Zone#	Depth	H	ØN	ØD	ØNC	Xplot	Ø	Pb	Δt	Δtc	Code	Rt	CP	Rtc	Sv4	DST	Perf.	By-passed OIP(mbo)
1	11288-97	9	-1.0	-10+	0.0	0.0	0.0	2.97	50.2	50.0	6Df	19K	1.27	24.0K	866	Yes		
2	11297-11300	3	4.0	-4.5	6.0	0.8	0.8	2.78	46.0	45.8	3AB	100	1.27	127.0	148	Yes		
3	11300-93	3	4.0	-7.0	5.0	0.0	0.0	2.82	46.1	45.9	4AC	110	1.27	139.7	21.3K	Yes		
4	11303-96	3	11.5	-1.8	12.5	5.4	2.74	51.6	51.4	4Bd	20	1.27	25.4	45	Yes		410	
5	11306-93	7	29.0	-18.5	30.0	24.3	2.41	76.0	75.8	4Df	40	2	1.27	25.4	34	Yes	Yes	
6	11313-19	6	2.0	-4.0	3.0	0.0	0.0	2.775	49.0	48.8	3Cc	15	1.27	50.8	8.8K	Yes		
7	11319-23	4	19.7	5.5	20.7	13.1	2.62	56.5	56.3	4Bd	15	1.27	19.1	23	Yes		Yes	
8	11323-26	3	4.9	-2.0	5.9	2.0	2.75	52.2	52.0	3Dd	13	1.27	16.5	165	Yes			
9	11328-30	4	5.1	0.0	6.1	3.1	2.70	53.0	52.8	3Dd	8	1.27	10.2	135	Yes			
10	11330-33	3	0.4	-3.2	1.4	0.0	2.76	48.8	48.6	3Cc	370	1.27	469.9	6.0K	Yes			
11	11333-37	4	1.0	1.5	2.0	1.8	2.685	50.6	50.4	2Cb	30	1.27	38.1	120	Yes			
12	11333-39	2	0.3	-0.9	1.3	0.2	2.725	52.0	51.8	2Dd	44	1.27	55.9	897	Yes			
13	11333-40	1	0.5	0.9	1.5	1.2	2.70	51.0	50.8	2Dc	40	1.27	50.7	156	Yes			
14	11340-42	2	0.5	0.0	1.5	0.8	2.705	51.1	50.9	2Dc	40	1.27	43.2	113	Yes			
15	11342-45	3	0.5	2.1	1.5	1.8	2.67	51.3	51.1	1Cb	34	1.27	139.7	1.4K	Yes			
16	11345-48	3	0.0	-1.2	1.0	0.0	2.73	50.0	49.8	2Cc	110	1.27	61.0	156	Yes			
17	11348-51	3	0.6	0.5	1.6	1.1	2.70	53.0	52.8	2Dd	48	1.27	254.0	210	Yes			
18	11351-54	3	0.5	-0.8	1.5	0.4	2.725	50.5	50.3	2Dc	200	1.27	47.0	177	Yes			
19	11354-56	2	1.4	-0.3	2.4	1.1	2.72	51.2	51.0	2Dc	37	1.27	20.3	595	Yes			
20	11356-57	1	2.0	-2.1	3.0	0.5	2.75	51.2	51.0	3Dd	16	1.27	12.7	125	Yes			
21	11357-60	3	5.0	0.0	6.0	3.0	2.71	52.0	51.8	3Dd	10	1.27	3.2	66	Yes			
22	11360-65	5	17.0	4.5	18.0	11.3	2.64	60.0	59.8	4Df	2.5	1.27	66.0	16.5K	Yes			
23	11365-68	3	1.1	-3.0	2.1	0.0	2.76	49.2	49.0	3Cc	52	1.27	61.0	429	Yes			
24	11368-69	1	1.7	-1.9	2.7	0.4	2.74	49.9	49.7	2Cc	48	1.27	127.0	11.9K	Yes			
25	11369-71	2	1.0	-2.5	2.0	0.0	2.75	49.3	49.1	3Cc	100	1.27	101.6	13.3K	Yes			
26	11371-73	2	1.1	0.0	2.1	1.1	2.705	50.9	50.7	2Dc	40	1.27	76.0	96	Yes			
27	11373-75	2	0.9	-2.0	1.9	0.0	2.745	50.0	49.8	2Cc	80	1.27	120.7	305	Yes			
28	11375-79	4	2.0	0.1	3.0	1.6	2.705	52.3	52.1	2Dd	95	1.27	48.3	193	Yes			
29	11378-84	5	0.8	-1.0	1.8	0.4	2.725	50.0	49.8	2Cc	38	1.27	76.2	15.4K	Yes			
30	11384-86	2	1.0	0.0	2.0	1.0	2.705	49.9	49.7	2Cc	60	1.27	127.0	595	Yes			
31	11386-88	2	0.6	-3.2	1.6	0.0	2.76	49.1	48.9	3Cc	100	1.27	127.0	5.1K	Yes			
32	11388-91	3	0.8	-1.4	1.8	0.2	2.73	49.0	48.8	2Cb	50	1.27	114.3	12.5K	Yes			
33	11391-93	2	0.4	-3.9	1.4	0.0	2.77	49.4	49.2	3Cc	75	1.27	95.3	274	Yes			
34	11393-96	3	0.9	-2.4	1.9	0.0	2.75	49.0	48.8	3Cc	90	1.27	558.8	5.7K	Yes			
35	11396-99	3	1.0	-1.1	2.0	0.5	2.725	52.0	51.8	2Dd	440	1.27	101.6	102	Yes			
36	11399-11400	1	1.1	-2.1	2.1	0.0	2.75	49.4	49.2	3Cc	80	1.27	101.6	13.3K	Yes			
37	11400-93	3	1.1	0.5	2.1	1.3	2.70	52.3	52.1	2Dc	80	1.27	38.1	271	Yes			
38	11403-98	5	0.8	-3.3	1.8	0.0	2.76	47.9	47.7	3Bc	30	1.27	127.0	11.9K	Yes			
39	11408-10	2	1.6	-1.0	2.6	0.8	2.72	50.0	49.8	2Cc	100	1.27	114.3	627	Yes			
40	11410-11	1	0.3	-2.4	1.3	0.0	2.75	48.7	48.5	2Cb	90	1.27	152.4	10.9K	Yes			
41	11411-13	2	0.2	-0.9	1.2	0.2	2.72	49.0	48.8	2Cb	120	1.27	152.4	10.9K	Yes			
42	11413-15	2	0.1	-1.7	1.1	0.0	2.73	48.5	48.3	2Cb	120	1.27	152.4	10.9K	Yes			
43	11415-17	3	0.1	-0.3	1.1	0.4	2.715	48.5	48.3	2Cb	120	1.27	152.4	10.9K	Yes			
44	11417-19	2	0.1	-4.1	1.1	0.0	2.78	48.6	48.4	3Cc	70	1.27	88.9	14.2K	Yes			
45	11419-21	2	0.2	-2.0	1.2	0.0	2.745	49.0	48.8	2Cc	85	1.27	108.0	12.9K	Yes			
46	11421-23	2	0.3	-3.0	1.3	0.0	2.755	48.8	48.6	3Cc	50	1.27	63.5	16.8K	Yes			
47	11423-25	2	0.3	-2.0	1.3	0.0	2.745	49.0	48.8	2Cc	70	1.27	31.8	237	Yes			
48	11425-29	4	0.4	-1.7	1.4	0.0	2.735	49.0	48.8	2Cc	25	1.27	69.9	16.0K	Yes			
49	11429-31	2	0.9	0.0	1.9	1.0	2.70	50.0	49.8	2Cb	55	1.27	49.5	476	Yes			
50	11431-34	3	0.3	-3.5	1.3	0.0	2.77	49.1	48.9	3Cc	39	1.27	76.2	15.4K	Yes			
51	11434-36	2	0.7	-1.0	1.7	0.4	2.72	49.5	49.3	2Cb	60	1.27	101.6	13.3K	Yes			
52	11436-38	2	0.5	-5.1	1.5	0.0	2.795	49.1	48.9	3Cc	34	1.27	43.2	204	Yes			
53	11438-39	1	0.5	-1.6	1.5	0.0	2.73	48.9	48.7	2Cb	24	1.27	30.5	19.8K	Yes			
54	11439-41	2	0.2	-3.0	1.2	0.0	2.75	49.0	48.8	2Cc	40	1.27	25.4	18.8K	Yes			
55	11441-43	2	0.9	0.0	1.9	1.0	2.705	49.9	49.7	2Cb	20	1.27	53.3	18.4K	Yes			
56	11443-46	2	0.8	-2.0	1.8	0.0	2.74	50.1	49.9	2Cc	42	1.27	44.5	223	Yes			
57	11446-48	2	1.0	-0.3	2.0	0.9	2.715	49.9	49.7	2Cc	35	1.27	63.5	16.8K	Yes			
58	11448-50	2	1.0	-0.3	2.0	0.9	2.715	49.9	49.7	2Cc	44	1.27	55.9	179	Yes			
59	11450-53	3	1.0	0.0	2.0	1.0	2.715	50.6	50.4	2Cc	70	1.27	63.5	210	Yes			
60	11453-55	2	0.7	-2.4	1.7	0.0	2.75	49.8	49.6	3Cc	50	1.27	101.6	13.3K	Yes			
61	11455-57	2	0.8	0.0	1.8	0.9	2.71	49.9	49.7	2Cb	42	1.27	53.3	18.4K	Yes			
62	11457-59	2	0.6	-1.9	1.6	0.0	2.735	49.9	49.7	2Cc	50	1.27	44.5	223	Yes			
63	11459-62	3	0.7	0.3	1.7	1.0	2.70	50.0	49.8	2Cb	44	1.27	55.9	179	Yes			
64	11462-65	3	0.3	-2.5	1.3	0.0	2.75	49.4	49.2	3Cc	70	1.27	63.5	210	Yes			
65	11465-67	2	0.5	0.0	1.5	0.8	2.705	49.7	49.5	2Cb	50	1.27	101.6	13.3K	Yes			
66	11467-80	3	0.1	-2.8	1.1	0.0	2.755	49.2	49.0	3Cc	80	1.27	101.6	13.3K	Yes			

Table E-18: Combined results of rock-typing and quantitative formation evaluation, Christensen #1, sesw 12-32N-58E.

Zone#	Depth	H	ϕ_m	ϕ_D	ϕ_{HC}	Xplot	ϕ	Pb	Δt	Δt_c	Code	Rt	CF	Rtc	Sw _h	DST	Perf.	By-passed OIP(MBO)
1	11382-91	9	-1.0	-10+	0.0	0.0	2.98	50.2	50.0	60f	30K	1.0	1.0	30K	774			
2	11391-99	8	2.0	-6.5	3.0	0.0	2.82	44.9	44.7	4Ab	300	1.0	1.0	300	7.7K			
3	11399-11402	3	0.3	-8.9	1.3	0.0	2.85	43.0	42.8	5Ab	1.0K	1.0	1.0	1.0K	4.2K			
4	11402-07	5	1.6	-6.3	2.6	0.0	2.81	45.0	44.8	4Ab	410	1.0	1.0	410	6.6K			
5	11407-08	1	0.1	-9.9	1.1	0.0	2.87	47.0	46.8	5Bd	330	1.0	1.0	330	7.4K			
6	11408-10	2	5.0	-7.9	6.0	0.0	2.83	45.0	44.8	4Ac	300	1.0	1.0	300	7.7K			
7	11410-12	2	3.4	-10+	4.4	0.0	8.89	46.0	45.8	5Ad	800	1.0	1.0	800	4.7K			
8	11412-14	2	7.2	-5.6	8.2	1.3	2.80	46.0	45.8	4Ab	140	1.0	1.0	140	87			
9	11414-15	1	6.2	-5.6	7.2	0.8	2.80	46.0	45.8	4Ab	90	1.0	1.0	90	176			1,609
10	11415-17	2	1.0	-3.0	11.0	4.0	2.75	46.9	5467	4Ab	50	1.0	1.0	50	46			1,589
11	11417-19	2	9.4	-4.0	10.4	3.2	2.77	47.9	47.7	4Ac	70	1.0	1.0	70	50			
12	11419-21	2	10.5	-1.8	11.5	4.9	2.74	49.3	49.1	4Ac	18	1.0	1.0	18	64			
13	11421-24	3	10.5	-2.3	11.5	4.6	2.75	48.0	47.8	4Ab	18	1.0	1.0	18	68			
14	11424-30	6	13.9	0.5	14.9	7.7	2.70	52.0	51.8	4Bc	11	1.0	1.0	11	52			
15	11430-32	2	2.1	1.2	22.0	17.0	2.51	58.0	57.8	3Ab	3.2	1.0	1.0	3.2	44			1,182
16	11432-34	2	17.2	6.8	18.2	12.5	2.60	56.2	56.0	4Bc	3.4	1.0	1.0	3.4	58			
17	11434-37	3	31.8	16.0	32.8	24.4	2.45	67.0	66.8	5Cf	1.8	1.0	1.0	1.8	40			1,817
18	11437-39	2	18.2	7.5	19.2	13.4	2.59	54.8	54.6	3Ab	3.5	1.0	1.0	3.5	53			
19	11439-40	1	20.9	10.7	21.9	16.3	2.535	60.0	59.8	4Cd	2.3	1.0	1.0	2.3	54			
20	11440-42	2	20.0	9.1	21.0	15.1	2.56	59.4	59.2	4Cd	2.3	1.0	1.0	2.3	57			
21	11442-43	1	23.4	9.3	24.4	16.9	2.55	60.0	59.8	4Bd	2.1	1.0	1.0	2.1	54			
22	11443-44	1	21.9	6.0	22.9	14.5	2.61	57.0	56.8	5Bd	2.6	1.0	1.0	2.6	57			
23	11444-50	6	23.1	6.8	24.1	15.5	2.595	57.3	57.1	5Bd	2.6	1.0	1.0	2.6	53			
24	11450-58	8	10.3	-1.8	11.3	4.8	2.74	50.1	49.9	4Bc	10.7	1.0	1.0	10.7	85			
25	11458-62	4	18.5	4.0	19.5	11.8	2.65	53.3	53.1	5Ac	6.0	1.0	1.0	6.0	46			1,266
26	11462-64	2	13.5	0.0	14.5	7.3	2.71	52.0	51.8	4Bd	23	1.0	1.0	23	38			449
27	11464-66	2	19.7	6.0	20.7	13.4	2.615	56.8	56.6	4Bd	34	1.0	1.0	34	17			1,104
28	11466-67	1	13.9	3.7	14.9	9.3	2.65	54.5	54.3	4Bb	80	1.0	1.0	80	16			582
29	11467-69	2	14.9	4.9	15.9	10.4	2.63	55.0	54.8	4Bc	50	1.0	1.0	50	18			635
30	11469-74	5	10.7	-1.0	11.7	5.4	2.725	52.1	51.9	4Cd	75	1.0	1.0	75	28			965
31	11474-77	3	22.8	10.0	23.8	16.9	2.55	61.0	60.8	4Ce	30	1.0	1.0	30	14			2,165
32	11477-80	3	20.1	9.3	21.1	15.2	2.56	51.0	60.8	4De	24	1.0	1.0	24	18			1,857
33	11480-84	4	28.3	13.0	29.3	21.2	2.50	66.0	65.8	5Df	17	1.0	1.0	17	75			
34	11484-87	3	8.9	1.0	9.9	4.5	2.725	51.5	51.3	4Cd	110	1.0	1.0	110	28			483
35	11487-89	2	14.0	2.2	15.0	8.6	2.67	52.4	52.2	4Bc	42	1.0	1.0	42	24			883
36	11489-91	2	3.2	-0.4	4.2	1.9	2.715	51.0	50.8	2Cc	100	1.0	1.0	100	70			
37	11491-94	3	10.0	4.5	11.0	7.8	2.64	56.6	56.4	3Dd	50	1.0	1.0	50	24			889
38	11494-97	3	3.0	-2.0	4.0	1.0	2.75	50.0	49.8	3Cc	110	1.0	1.0	110	127			
39	11497-11504	7	21.0	8.0	22.0	15.0	2.58	61.1	60.9	4Df	20	1.0	1.0	20	20			4,171
40	11504-12	8	1.0	-1.8	2.0	0.1	2.74	48.5	48.3	2Cb	70	1.0	1.0	70	1.6K			
41	11512-16	4	2.9	1.0	3.9	2.5	2.70	51.0	50.8	2Cc	20	1.0	1.0	20	120			
42	11516-17	1	8.8	2.0	9.8	5.9	2.67	54.0	53.8	3Cd	11	1.0	1.0	11	68			
43	11517-19	2	5.1	-0.2	6.1	3.0	2.72	51.8	51.6	3Cd	20	1.0	1.0	20	99			
44	11519-21	2	10.5	2.0	11.5	6.8	2.68	54.9	54.7	3Cd	15	1.0	1.0	15	50			338
45	11521-23	2	2.8	-1.0	3.8	1.4	2.725	51.2	51.0	2Dc	32	1.0	1.0	32	168			
46	11523-25	2	14.1	4.0	15.1	9.6	2.65	57.0	56.8	4De	16	1.0	1.0	16	38			560
47	11525-26	1	6.0	0.0	7.0	3.5	2.71	51.3	51.1	3Cc	32	1.0	1.0	32	67			
48	11526-28	2	10.4	2.0	11.4	6.7	2.68	53.3	53.3	3Cd	14	1.0	1.0	14	53			

Table E-19: Combined results of rock-typing and quantitative formation evaluation, Rasmussen #13-2, none 13-32N-58E.

Zone#	Depth	H	ρ _w	ρ _D	ρ _{ac}	Xplot	ρ _b	Δt	Δtc	Code	Rt	CF	Rtc	Swt	DST	Perf.	By-passed OIP(MBO)
1	11504-13	9	-2.6	-10+	0.0	0.0	2.93	50.0	50.0	6Df	2K	0.86	1.7K	3.3K	Yes		
2	11513-18	5	14.0	2.0	16.6	9.3	2.68	49.1	49.1	4Ab	19	0.86	16.3	35	Yes		1,501
3	11518-21	3	10.0	-2.1	12.6	5.3	2.75	46.8	46.8	4Ab	28	0.86	24.1	51	Yes		
4	11521-25	4	22.3	12.0	24.9	18.5	2.52	63.0	63.0	4Df	1.2	0.86	1.0	72	Yes		
5	11525-28	3	14.8	5.4	17.4	11.4	2.62	61.0	61.0	4Df	1.3	0.86	1.1	112	Yes		
6	11528-31	3	15.7	7.0	18.3	12.7	2.60	56.5	56.5	4Df	2.0	0.86	1.7	81	Yes		
7	11531-34	3	12.0	2.0	14.6	8.3	2.675	48.5	48.5	4Aa	30	0.86	25.8	31			995
8	11534-35	1	14.0	4.2	16.6	10.4	2.64	52.1	52.1	4Ab	22	0.86	18.9	29			367
9	11535-38	3	12.1	2.5	14.7	8.6	2.67	51.3	51.3	4Ab	22	0.86	18.9	35			654
10	11538-41	3	14.0	5.6	16.6	11.1	2.62	52.0	52.0	4Ab	4.2	0.86	3.6	63			
11	11541-44	3	12.1	2.0	14.7	8.4	2.675	49.2	49.2	4Ab	10.2	0.86	8.8	53			
12	11544-50	6	18.1	8.8	20.7	14.8	2.57	54.0	54.0	4Ab	10	0.86	8.6	61			
13	11550-56	6	8.1	4.0	10.7	7.4	2.64	51.5	51.5	3Bb	10	0.86	17.2	85			
14	11556-62	6	3.9	1.0	6.5	3.8	2.69	50.3	50.3	3Bb	20	0.86	0.9	68			
15	11562-64	2	23.6	13.1	26.2	19.7	2.495	65.1	65.1	4Df	1.0	0.86	1.6	71			
16	11564-66	2	18.5	8.7	21.1	14.9	2.57	56.7	56.7	4Bc	1.8	0.86	1.5	66			
17	11566-71	5	20.0	10.2	22.6	16.4	2.54	56.8	56.8	4Ab	1.7	0.86	2.6	58			
18	11571-74	3	18.9	7.0	21.5	14.3	2.60	53.9	53.9	5Ab	3.0	0.86	2.2	54			
19	11574-76	2	20.8	10.0	23.4	16.7	2.55	55.3	55.3	4Ab	2.6	0.86	2.3	64			
20	11576-80	4	18.7	6.0	21.3	13.7	2.61	53.8	53.8	4Ab	2.7	0.86	1.6	73			
21	11580-83	3	21.0	10.0	23.6	16.8	2.55	57.4	57.4	4Ac	1.9	0.86	1.7	73			
22	11583-87	4	17.4	8.0	20.0	14.0	2.57	54.4	54.4	4Ab	2.0	0.86	1.5	76			
23	11587-89	2	19.5	6.5	22.1	14.3	2.60	56.0	56.0	5Bc	1.7	0.86	7.7	56			
24	11589-91	2	10.6	3.9	13.2	8.6	2.65	51.9	51.9	3Ab	9	0.86	7.7	48			1,291
25	11591-96	5	12.2	5.2	14.8	10.0	2.625	54.4	54.4	3Bc	9	0.86	9.3	62			
26	11596-02	6	8.0	3.3	10.6	7.0	2.65	52.0	52.0	3Bb	10.8	0.86	1.7	55			
27	11602-10	8	22.0	12.5	24.6	18.6	2.51	63.2	63.2	4Df	2.0	0.86	17.2	56			
28	11610-14	4	7.7	1.1	10.3	5.7	2.695	50.7	50.7	3Bc	8	0.86	6.9	44			968
29	11614-17	3	14.0	6.5	16.6	11.6	2.60	54.0	54.0	3Ab	20.1	0.86	17.3	53			
30	11617-19	2	9.3	0.0	11.9	6.0	2.71	52.0	52.0	4Cd	10	0.86	8.6	39			886
31	11619-22	3	16.5	4.2	19.1	11.7	2.635	55.0	55.0	4Bd	29	0.86	24.9	53			
32	11622-26	4	8.0	-0.6	10.6	5.0	2.72	52.0	52.0	4Cd	3.0	0.86	2.6	51			
33	11626-31	5	19.6	10.0	22.2	16.1	2.55	61.2	61.2	4Ce	16	0.86	13.8	100			
34	11631-39	8	6.5	-1.9	9.1	3.6	2.74	49.7	49.7	4Bc	6	0.86	5.2	72			
35	11639-44	5	9.5	4.0	12.1	8.1	2.65	52.5	52.5	3Bc	8	0.86	6.9	77			
36	11644-49	5	10.0	0.5	12.6	6.6	2.70	51.8	51.8	4Bc	4.3	0.86	3.7	84			
37	11649-51	2	11.0	3.0	13.6	8.3	2.66	53.2	53.2	4Bc	6	0.86	5.2	81			
38	11651-53	2	9.7	2.0	12.3	7.2	2.67	51.0	51.0	3Bb	3	0.86	2.6	66			
39	11653-55	2	14.5	8.0	17.1	12.6	2.58	56.9	56.9	3Cc	4.1	0.86	3.5	83			
40	11655-58	3	10.0	4.5	12.6	8.6	2.635	53.0	53.0	3Bc	6	0.86	4.7	79			
41	11658-61	3	8.7	0.1	11.3	5.7	2.70	51.1	51.1	3Bc	5.5	0.86	6.9	75			
42	11661-63	2	9.9	3.0	12.5	7.8	2.605	52.0	52.0	2Ba	8	0.86	4.0	63			
43	11663-65	2	8.4	2.6	11.0	6.8	2.615	52.0	52.0	2Bb	6	0.86	5.2	67			
44	11665-66	1	13.5	5.0	15.9	10.5	2.63	54.9	54.9	4Bc	5	0.86	4.3	67			
45	11666-68	2	11.6	2.8	14.2	8.5	2.66	51.6	51.6	4Ab	19	0.86	16.3	67			302
46	11668-70	2	11.6	5.0	14.2	9.6	2.625	53.6	53.6	3Bc	17	0.86	14.6	46			
47	11670-72	2	7.9	-0.8	10.5	4.9	2.72	50.0	50.0	4Bc	18	0.86	15.5	67			
48	11672-74	2	9.5	2.8	12.1	7.5	2.67	51.0	51.0	3Ab	19	0.86	16.3	102			
49	11674-75	1	5.6	1.0	7.6	4.3	2.70	49.3	49.3	3Bb	38	0.86	32.7	42			132
50	11675-77	2	5.0	2.2	7.6	4.9	2.67	51.0	51.0	3Bb	39	0.86	33.5	73			
51	11677-79	2	2.9	-0.9	5.5	2.3	2.72	49.9	49.9	3Cc	50	0.86	43.0	52			
52	11679-82	3	4.5	3.6	7.1	5.4	2.65	50.0	50.0	2Ba	47	0.86	40.4	73			
53	11682-85	3	3.0	0.0	5.6	2.8	2.70	49.0	49.0	2Bb	50	0.86	43.0	62			
54	11685-87	2	4.0	1.4	6.6	4.0	2.68	49.0	49.0	2Bb	49	0.86	42.1	139			
55	11687-90	3	2.9	0.0	5.5	2.8	2.70	48.9	48.9	2Bb	75	0.86	64.5	77			
56	11690-93	3	3.0	0.9	5.6	3.3	2.695	48.9	48.9	2Bb		0.86					
57	11693-96	3	1.8	-2.0	4.4	1.2	2.74	48.8	48.8	3Cc		0.86					

Table E-20: Combined results of rock-typing and quantitative formation evaluation, Willie Bee #2, some 24-32N-58E.

Zone#	Depth	H	g _m	g _D	g _{mc}	Xplot	g	Pb	Δt	Δtc	Code	Rt	CP	Rtc	Sat	DST	Perf.	By-passed OIP(MBO)
1	11516-26	10	-1.1	-10+	0.0	0.0	2.975	50.0	50.0	60f	35K	1.0	35K	717				
2	11526-30	4	4.6	-4.0	5.7	0.9	2.775	47.0	47.0	30c	110	1.0	110	142	Yes	Yes		
3	11530-36	6	3.9	-4.4	5.0	0.3	2.785	46.7	46.7	30c	120	1.0	120	408	Yes	Yes		
4	11536-46	10	26.4	16.3	27.5	21.9	2.495	63.0	63.0	50e	21	1.0	21	13	Yes	Yes		9,460
5	11546-50	4	4.0	3.7	5.1	4.4	2.81	46.7	46.7	50c	300	1.0	300	17	Yes	Yes		725
6	11550-52	2	24.0	13.0	25.1	19.1	2.50	56.5	56.5	40a	9	1.0	9	23	Yes	Yes		1,460
7	11552-54	2	11.0	3.9	12.1	8.0	2.645	51.7	51.7	30b	14	1.0	14	44	Yes	Yes		445
8	11554-56	2	14.3	5.2	15.4	10.3	2.62	53.0	53.0	30b	6.8	1.0	6.8	49	Yes	Yes		552
9	11556-58	2	4.3	2.0	5.4	2.7	2.68	50.8	50.8	20b	10.1	1.0	10.1	114	Yes	Yes		
10	11558-60	2	16.0	2.9	17.1	10.0	2.66	51.6	51.6	40b	10	1.0	10	42	Yes	Yes		720
11	11560-64	4	0.0	0.0	1.1	0.6	2.71	49.0	49.0	20b	530	1.0	530	97	Yes	Yes		
12	11564-67	3	0.7	2.2	1.8	2.0	2.67	49.5	49.5	20b	110	1.0	110	63	Yes	Yes		
13	11567-85	18	0.0	2.0	1.1	1.6	2.675	49.0	49.0	20a	900	1.0	900	27	Yes	Yes		1,044
14	11585-88	3	12.1	7.8	13.2	10.5	2.58	56.0	56.0	30c	5.3	1.0	5.3	55	Yes	Yes		
15	11588-91	3	9.7	3.1	10.8	7.0	2.655	54.0	54.0	30c	10	1.0	10	60	Yes	Yes		
16	11591-95	4	26.3	20.3	27.4	23.9	2.38	70.5	70.5	30f	5.8	1.0	5.8	23	Yes	Yes		
17	11595-98	3	19.1	11.0	20.2	16.6	2.53	60.0	60.0	40d	9	1.0	9	26	Yes	Yes		
18	11598-11601	3	24.0	9.5	25.1	17.3	2.555	60.8	60.8	50c	7	1.0	7	29	Yes	Yes		
19	11601-03	2	4.0	-0.7	5.1	2.2	2.72	50.0	50.0	30c	60	1.0	60	78	Yes	Yes		224
20	11603-04	1	8.0	1.0	9.1	5.1	2.695	53.5	53.5	30d	40	1.0	40	41	Yes	Yes		
21	11604-06	2	4.3	-0.8	5.4	2.3	2.72	50.0	50.0	30c	59	1.0	59	75	Yes	Yes		
22	11606-07	1	5.4	0.7	6.5	3.6	2.70	50.7	50.7	30c	38	1.0	38	60	Yes	Yes		
23	11607-08	1	2.0	0.0	3.1	1.6	2.71	49.0	49.0	20b	110	1.0	110	79	Yes	Yes		
24	11608-11	3	6.0	1.0	7.1	4.1	2.69	49.0	49.0	30b	46	1.0	46	48	Yes	Yes		318
25	11611-13	2	4.8	-2.0	5.9	2.0	2.74	50.2	50.2	30c	62	1.0	62	85	Yes	Yes		
26	11613-16	3	10.6	4.0	11.7	7.9	2.645	54.5	54.5	30d	20	1.0	20	37	Yes	Yes		
27	11616-18	2	18.2	10.0	19.3	15.0	2.54	60.0	60.0	30d	12	1.0	12	25	Yes	Yes		
28	11618-21	3	10.9	7.5	12.0	9.8	2.585	55.0	55.0	20b	20	1.0	20	30	Yes	Yes		
29	11621-24	3	2.0	-3.0	3.1	0.1	2.755	49.0	49.0	30c	240	1.0	240	866	Yes	Yes		
30	11624-26	2	10.8	4.8	11.9	8.4	2.63	53.0	53.0	30b	60	1.0	60	20	Yes	Yes		
31	11626-29	3	2.8	-1.7	3.9	1.1	2.735	49.7	49.7	30c	270	1.0	270	74	Yes	Yes		
32	11629-32	3	14.0	6.7	15.1	10.9	2.60	56.7	56.7	20d	43	1.0	43	17	Yes	Yes		
33	11632-35	3	2.0	-0.7	3.1	1.2	2.72	49.5	49.5	30c	650	1.0	650	43	Yes	Yes		
34	11635-37	2	11.0	4.0	12.1	8.1	2.65	55.0	55.0	30d	11	1.0	11	49	Yes	Yes		
35	11637-38	1	9.9	1.0	11.0	6.0	2.69	54.6	54.6	30e	13	1.0	13	62	Yes	Yes		
36	11638-42	4	15.9	3.4	17.0	10.2	2.65	55.0	55.0	40d	11	1.0	11	39	Yes	Yes		
37	11642-52	10	0.9	-2.5	2.0	0.0	2.75	47.5	47.5	30b	260	1.0	260	8.3K	Yes	Yes		
38	11652-55	3	6.8	0.0	7.9	4.0	2.71	52.6	52.6	30d	10	1.0	10	106	Yes	Yes		
39	11655-57	2	3.9	-1.8	5.0	1.6	2.735	50.0	50.0	30c	21	1.0	21	182	Yes	Yes		
40	11657-59	2	6.0	1.0	7.1	3.1	2.695	51.5	51.5	20c	15	1.0	15	111	Yes	Yes		
41	11659-61	2	2.3	-1.3	2.4	0.6	2.73	50.0	50.0	20c	50	1.0	50	316	Yes	Yes		
42	11661-63	2	10.7	2.3	11.8	7.1	2.67	50.0	50.0	30d	14	1.0	14	50	Yes	Yes		353
43	11663-64	1	3.0	-1.2	4.1	1.5	2.73	50.0	50.0	30c	25	1.0	25	178	Yes	Yes		
44	11664-65	1	4.4	-1.0	5.5	2.3	2.72	51.5	51.5	30d	18	1.0	18	137	Yes	Yes		
45	11665-67	2	4.6	-3.2	5.7	1.3	2.76	51.0	51.0	30d	21	1.0	21	225	Yes	Yes		
46	11667-69	2	6.0	-1.2	7.1	3.0	2.725	51.5	51.5	30d	20	1.0	20	99	Yes	Yes		
47	11669-72	3	4.0	-3.0	5.1	1.1	2.755	50.0	50.0	30d	30	1.0	30	222	Yes	Yes		

Table E-21: Combined results of rock-typing and quantitative formation evaluation, Union Mortgage #1-29, nese 29-32N-58E.

Zone#	Depth	H	ρ _m	ρ ₀	ρ _{bc}	Xplot	φ	Pb	Δt	Δtc	Code	Rt	CP	Rtc	Swt	DST	Perf.	By-passed OIP(MBO)
1	11471-80	9	-1.0	-10+	0.0	0.0	0.0	2.98	50.4	50.0	6Df	53K	0.5	26.5K	824	Yes		
2	11480-83	3	12.5	6.0	13.5	9.8	9.8	2.61	49.2	48.8	3Aa	34	0.5	17	33	Yes		1,247
3	11483-88	5	8.0	-2.9	9.0	3.5	3.5	2.75	47.0	46.6	4Ab	80	0.5	40	60	Yes		
4	11488-92	4	32.0	20.7	33.0	26.9	26.9	2.38	70.0	69.6	5Df	4.2	0.5	2.1	34	Yes	Yes	
5	11492-93	1	10.3	2.0	11.3	6.7	6.7	2.675	61.2	60.8	3Df	4	0.5	2	141	Yes	Yes	
6	11493-96	3	18.0	8.9	19.0	14.0	14.0	2.565	63.7	63.3	4Df	3.8	0.5	1.9	69	Yes	Yes	
7	11496-99	3	7.3	1.0	8.3	4.7	4.7	2.69	53.1	52.7	3Cd	20	0.5	10	90	Yes	Yes	
8	11499-11500	1	13.0	4.8	14.0	9.4	9.4	2.63	54.0	53.6	3Bc	17	0.5	8.5	48	Yes	Yes	
9	11500-02	2	11.2	2.0	12.2	7.1	7.1	2.68	49.8	49.4	4Ab	38	0.5	19	43	Yes	Yes	
10	11502-04	2	17.8	15.5	18.8	17.2	17.2	2.445	55.5	55.1	2Aa	19	0.5	9.5	25	Yes	Yes	
11	11504-08	4	14.0	8.0	15.0	11.5	11.5	2.58	52.0	51.6	3Aa	40	0.5	20	26	Yes	Yes	
12	11508-13	5	10.0	0.7	11.0	5.9	5.9	2.705	50.0	49.6	4Ab	70	0.5	35	38	Yes	Yes	908
13	11513-14	1	12.0	4.7	13.0	8.9	8.9	2.635	50.4	50.0	3Aa	13	0.5	6.5	59	Yes	Yes	
14	11514-17	3	11.3	-1.0	12.3	5.7	5.7	2.725	48.8	48.4	4Ab	27	0.5	13.5	64	Yes	Yes	
15	11517-23	6	20.9	8.0	21.9	15.0	15.0	2.58	58.0	57.6	4Bd	3.2	0.5	1.6	70	Yes	Yes	
16	11523-28	5	6.0	2.0	7.0	4.0	4.0	2.68	52.9	52.5	3Cc	10	0.5	5	133	Yes	Yes	
17	11528-31	3	21.0	10.0	22.0	16.0	16.0	2.55	59.5	59.1	4Bd	3.2	0.5	1.6	66	Yes	Yes	
18	11531-33	2	15.2	3.7	16.2	10.0	10.0	2.65	53.9	53.5	4Bc	5	0.5	2.5	80	Yes	Yes	
19	11533-36	3	17.0	6.2	18.0	12.1	12.1	2.61	55.2	54.8	4Bc	4.2	0.5	2.1	76	Yes	Yes	
20	11536-40	4	11.0	1.7	12.0	6.9	6.9	2.68	53.0	52.6	3Bc	10	0.5	5	86	Yes	Yes	
21	11540-46	6	7.7	-1.9	8.7	3.4	3.4	2.74	49.4	49.0	3Bc	17	0.5	8.5	135	Yes	Yes	
22	11546-51	5	20.2	6.1	21.2	13.7	13.7	2.605	55.4	55.0	4Ac	5.8	0.5	2.9	57	Yes	Yes	
23	11551-55	4	13.3	0.0	14.3	7.2	7.2	2.71	51.7	51.3	4Bc	20	0.5	10	58	Yes	Yes	
24	11555-59	4	22.4	8.0	23.4	15.7	15.7	2.575	59.0	58.6	4Bd	17	0.5	8.5	29	Yes	Yes	2,214
25	11559-61	2	11.0	1.0	12.0	6.5	6.5	2.695	53.6	53.2	4Cd	33	0.5	16.5	50	Yes	Yes	403
26	11561-63	2	16.0	5.0	17.0	11.0	11.0	2.625	56.0	55.6	4Bd	10	0.5	5	54	Yes	Yes	
27	11563-66	3	10.6	3.0	11.6	7.1	7.1	2.66	54.9	54.5	3Cd	12	0.5	6	75	Yes	Yes	
28	11566-69	3	28.7	14.0	29.7	21.9	21.9	2.48	64.0	63.6	5Cc	3	0.5	1.5	50	Yes	Yes	1,631
29	11569-71	2	13.8	4.0	14.8	9.4	9.4	2.64	55.8	55.4	4Cd	7	0.5	3.5	76	Yes	Yes	
30	11571-74	3	20.0	9.0	21.0	15.0	15.0	2.565	60.3	59.9	4Cc	5.5	0.5	2.8	53	Yes	Yes	
31	11574-76	2	4.0	-2.0	5.0	1.5	1.5	2.75	50.0	49.6	3Cc	34	0.5	17	216	Yes	Yes	
32	11576-78	2	12.0	3.3	13.0	8.2	8.2	2.65	53.1	52.7	3Bc	20	0.5	10	51	Yes	Yes	
33	11578-81	3	5.0	0.0	6.0	3.0	3.0	2.71	50.0	49.6	3Bb	60	0.5	30	81	Yes	Yes	
34	11581-84	3	6.4	2.7	7.4	5.1	5.1	2.66	53.0	52.6	2Cc	40	0.5	20	58	Yes	Yes	
35	11584-86	2	2.0	-2.0	3.0	0.5	0.5	2.74	50.0	49.6	2Cc	70	0.5	35	453	Yes	Yes	
36	11586-90	4	10.1	0.8	11.1	6.0	6.0	2.70	52.5	52.1	4Bc	7.5	0.5	3.8	114	Yes	Yes	
37	11590-94	4	16.0	6.0	17.0	11.5	11.5	2.62	55.9	55.5	4Bd	7	0.5	3.5	62	Yes	Yes	
38	11594-11604	10	1.0	-1.0	2.0	0.5	0.5	2.73	48.5	48.1	2Bb	50	0.5	25	536	Yes	Yes	
39	11604-10	6	10.0	2.2	11.0	6.7	6.7	2.665	55.0	54.6	3Cd	5	0.5	2.5	126	Yes	Yes	
40	11610-13	3	6.0	0.0	7.0	3.5	3.5	2.71	50.0	49.6	3Bb	13	0.5	6.5	150	Yes	Yes	
41	11613-14	1	14.0	5.8	15.0	10.4	10.4	2.63	54.0	53.6	4Bc	6	0.5	3	74	Yes	Yes	
42	11614-16	2	6.0	-2.9	7.0	2.1	2.1	2.75	50.0	49.6	3Cc	12	0.5	6	260	Yes	Yes	
43	11616-20	4	8.0	1.2	9.0	5.1	5.1	2.69	50.9	50.5	3Bb	8.8	0.5	4.4	125	Yes	Yes	
44	11620-25	5	5.6	0.0	6.6	3.3	3.3	2.70	50.9	50.5	3Cc	17	0.5	8.5	139	Yes	Yes	
45	11625-26	1	11.0	2.2	12.0	7.1	7.1	2.67	52.9	52.5	3Bc	5.3	0.5	2.7	114	Yes	Yes	
46	11626-28	2	8.5	0.0	9.5	4.8	4.8	2.71	52.0	51.6	3Cc	8	0.5	4	139	Yes	Yes	
47	11628-30	2	9.6	4.0	10.6	7.3	7.3	2.65	52.0	51.6	3Bb	6.5	0.5	3.3	101	Yes	Yes	
48	11630-31	1	2.0	-1.0	3.0	1.0	1.0	2.72	49.1	48.7	2Cb	27	0.5	13.5	365	Yes	Yes	
49	11631-35	4	3.1	0.0	4.1	2.1	2.1	2.71	49.7	49.3	2Bb	20	0.5	10	202	Yes	Yes	
50	11635-37	2	1.4	-3.8	2.4	0.0	0.0	2.76	49.0	48.6	3Cc	60	0.5	30	24.5K	Yes	Yes	
51	11637-39	2	1.5	0.6	2.5	1.6	1.6	2.70	49.7	49.3	2Cb	35	0.5	17.5	200	Yes	Yes	
52	11639-40	1	0.8	-1.5	1.8	0.2	0.2	2.73	49.0	48.6	2Cb	62	0.5	31	200	Yes	Yes	
53	11640-43	3	0.3	0.2	1.3	0.8	0.8	2.70	49.8	49.4	2Cb	90	0.5	45	200	Yes	Yes	
54	11643-47	4	0.9	-1.4	1.9	0.3	0.3	2.73	48.5	48.1	2Bb	85	0.5	42.5	685	Yes	Yes	
55	11647-49	2	0.9	0.0	1.9	1.0	1.0	2.71	48.6	48.2	2Bb	90	0.5	60	200	Yes	Yes	
56	11649-50	1	0.8	-1.6	1.8	0.1	0.1	2.735	48.1	47.7	2Bb	120	0.5	55	17K	Yes	Yes	
57	11650-54	4	0.5	0.5	1.5	1.0	1.0	2.70	48.4	48.0	2Bb	110	0.5	55	180	Yes	Yes	
58	11654-56	2	0.6	-2.0	1.6	0.0	0.0	2.74	48.3	47.9	2Bb	110	0.5	55	18.1K	Yes	Yes	
59	11656-59	3	0.5	0.0	1.5	0.8	0.8	2.71	48.1	47.7	2Bb	100	0.5	50	237	Yes	Yes	

Table E-22: Combined results of rock-typing and quantitative formation evaluation, Bagassan #1-9, zone 9-32N-59E.

Zone#	Depth	H	μ_m	μ_D	μ_{ac}	Xplot	ϕ	Pb	Δt	Δt_c	Code	Rt	CP	Rtc	Swf	DST	Perf.	By-passed OIP(MBO)
1	11761-68	7	-0.9	-10.4	0.0	0.0	0.0	2.96	50.0	50.0	60f	8K	1.0	8K	1.5K			
2	11768-74	6	10.0	-0.6	10.5	5.2	2.72	48.8	48.8	48.8	4Ab	18	1.0	18	60			
3	11774-76	2	7.0	-3.3	7.9	2.3	2.76	46.0	46.0	46.0	3Ab	51	1.0	51	81			
4	11776-77	1	8.9	-1.3	9.8	4.3	2.73	49.1	49.1	49.1	4Bc	40	1.0	40	49			108
5	11777-79	2	0.9	-1.3	1.8	0.3	2.73	49.1	49.1	49.1	2Cc	41	1.0	41	698			
6	11779-81	2	1.0	0.8	1.9	1.4	2.695	50.1	50.1	50.1	2Cb	13	1.0	13	265			
7	11781-83	2	0.5	0.4	1.4	0.9	2.705	49.9	49.9	49.9	2Cb	25	1.0	25	298			
8	11783-85	2	0.9	2.0	1.8	1.9	2.685	50.0	50.0	50.0	2Cb	19	1.0	19	161			
9	11785-88	3	0.4	0.0	1.3	0.7	2.71	48.0	48.0	48.0	2Bb	36	1.0	36	139			
10	11788-90	2	7.1	3.8	8.0	5.9	2.65	50.1	50.1	50.1	2Ba	12	1.0	12	65			
11	11790-92	2	1.4	-2.0	1.3	6.2	2.75	49.0	49.0	49.0	3Cc	80	1.0	80	749			
12	11792-96	4	6.0	4.1	6.9	5.5	2.64	53.1	53.1	53.1	2Cc	11	1.0	11	73			
13	11796-99	3	0.8	1.4	1.4	1.6	2.695	49.9	49.9	49.9	2Cb	50	1.0	50	118	Yes		
14	11799-11802	3	1.2	3.1	2.1	2.6	2.66	51.0	51.0	51.0	2Ca	24	1.0	24	105	Yes		
15	11802-05	3	0.1	0.8	1.0	0.9	2.70	49.9	49.9	49.9	2Cb	100	1.0	100	149	Yes		
16	11805-06	1	0.6	2.0	1.5	1.8	2.675	50.1	50.1	50.1	2Cb	48	1.0	48	117	Yes		
17	11806-08	2	0.7	2.0	1.6	1.2	2.70	50.1	50.1	50.1	2Cb	80	1.0	80	124	Yes		
18	11808-10	2	0.8	2.4	1.7	2.1	2.67	50.7	50.7	50.7	2Cb	36	1.0	36	106	Yes		
19	11810-13	3	0.1	0.2	1.0	0.6	2.71	49.8	49.8	49.8	2Cc	100	1.0	100	223	Yes		
20	11813-24	11	1.6	4.7	2.5	3.6	2.64	52.0	52.0	52.0	1Cb	56	1.0	56	49	Yes		999
21	11824-30	6	0.8	1.1	1.0	1.4	2.69	50.9	50.9	50.9	2Cb	71	1.0	71	113			
22	11830-35	5	29.0	16.1	29.9	23.0	2.45	71.4	74.4	74.4	50f	1.1	1.0	1.1	55			
23	11835-37	2	15.0	6.3	15.9	11.1	2.605	61.0	61.0	61.0	30f	3.1	1.0	3.1	68			
24	11837-40	3	22.0	7.5	22.9	15.2	2.59	61.6	61.6	61.6	50f	2.1	1.0	2.1	60			
25	11840-41	1	2.5	-2.0	3.4	0.7	2.745	49.2	49.2	49.2	3Cc	24	1.0	24	391			
26	11841-44	3	5.0	0.5	5.9	3.2	2.70	52.0	52.0	52.0	3Cc	13	1.0	13	116			
27	11844-47	3	1.9	0.4	2.8	1.6	2.70	50.5	50.5	50.5	2Cc	35	1.0	35	141			
28	11847-51	4	3.5	2.0	4.4	3.2	2.68	50.9	50.9	50.9	2Cb	17	1.0	17	101			
29	11851-56	5	2.1	2.0	3.0	2.5	2.675	51.1	51.1	51.1	2Cb	33	1.0	33	93			
30	11856-58	2	1.4	1.2	2.3	1.8	2.69	49.9	49.9	49.9	2Cb	60	1.0	60	96			
31	11858-61	3	2.5	2.0	3.4	2.7	2.68	50.9	50.9	50.9	2Cb	16	1.0	16	124			
32	11861-73	12	0.9	0.0	1.8	0.9	2.71	49.7	49.7	49.7	2Cb	160	1.0	160	117			
33	11873-75	2	1.8	2.4	2.7	2.6	2.67	52.3	52.3	52.3	2Cc	185	1.0	185	50			
34	11875-77	2	1.3	0.8	2.2	1.5	2.70	50.0	50.0	50.0	2Cb	110	1.0	110	85			
35	11877-80	3	1.5	1.7	2.4	2.1	2.685	53.5	53.5	53.5	2Cb	40	1.0	40	101			
36	11880-83	3	0.1	-2.0	1.0	0.0	2.75	48.6	48.6	48.6	3Cc	210	1.0	210	9.3K			
37	11883-87	4	1.5	0.4	2.4	1.4	2.705	50.0	50.0	50.0	2Cc	26	1.0	26	187			
38	11887-89	2	0.5	-1.3	1.4	0.1	2.73	49.0	49.0	49.0	2Cc	50	1.0	50	1.9K			
39	11889-97	8	0.4	0.4	1.3	0.9	2.70	48.9	48.9	48.9	2Cb	50	1.0	50	210			
40	11897-99	2	0.5	-1.4	1.4	0.0	2.735	49.0	49.0	49.0	2Cc	60	1.0	60	17.3K			
41	11899-11901	2	0.6	0.6	1.5	1.1	2.70	49.2	49.2	49.2	2Cb	30	1.0	30	222			
42	11901-03	2	0.6	-1.0	1.5	0.3	2.73	49.2	49.2	49.2	2Cc	45	1.0	45	666			
43	11903-05	2	1.0	0.5	1.9	1.2	2.70	49.9	49.9	49.9	2Cb	25	1.0	25	223			
44	11905-07	2	0.7	-0.5	1.6	0.1	2.72	49.3	49.3	49.3	2Cb	40	1.0	40	2.1K			
45	11907-10	3	1.2	0.7	2.1	1.4	2.70	50.0	50.0	50.0	2Cb	20	1.0	20	214			
46	11910-11	1	0.7	-0.8	1.6	0.4	2.725	49.4	49.4	49.4	2Cc	48	1.0	48	530			
47	11911-15	4	1.0	1.3	1.9	1.6	2.69	49.7	49.7	49.7	2Cb	27	1.0	27	161			

Table E-23: Combined results of rock-typing and quantitative formation evaluation, Maline Kidness #1, saws 6-33W-56E.

Zone#	Depth	H	SH	SD	SHC	Xplot	PH	Δt	Δtc	Code	Rt	CP	Rtc	Swt	DST	Perf.	By-passed OIP(MBO)
1	10811-20	8	-0.8	-10+	0.0	0.0	2.96	52.2	50.0	Gof	20K	1.0	20K	948			
2	10820-23	3	5.4	-3.5	6.2	1.4	2.76	48.7	46.5	3ab	70	1.0	70	114			
3	10823-28	5	7.3	-2.5	8.1	2.3	2.75	50.2	48.0	3bb	20	1.0	20	167			
4	10828-32	4	1.0	-8.1	1.8	0.0	2.85	46.0	43.8	5ab	300	1.0	300	7.7K			
5	10832-34	2	2.8	-5.2	3.6	0.0	2.80	48.0	45.8	4ab	100	1.0	100	13.4K			
6	10834-38	4	1.4	-7.5	2.2	0.0	2.83	46.0	43.8	4ab	1.2K	1.0	1.2K	3.9K			
7	10838-42	4	5.7	-4.4	6.5	1.0	2.78	49.0	46.8	3bc	36	1.0	36	283			
8	10842-45	3	7.0	-3.0	7.8	2.3	2.76	51.0	48.8	4bc	80	1.0	80	62			
9	10845-47	2	14.0	2.0	14.8	8.3	2.675	52.9	50.7	4ab	75	1.0	75	18			
10	10847-49	2	8.0	-2.0	8.8	3.4	2.74	51.0	48.8	3bc	21	1.0	21	96			
11	10849-50	1	11.5	-1.0	12.3	5.7	2.725	52.0	49.8	4bc	14	1.0	14	62			
12	10850-54	4	9.0	-1.4	9.8	4.2	2.785	51.2	49.0	5bd	15	1.0	15	82			
13	10854-58	4	21.0	5.5	21.8	13.7	2.62	57.7	55.5	5bd	1.7	1.0	1.7	75			
14	10858-62	4	2.0	2.6	2.8	2.7	2.67	53.0	50.8	2cb	12	1.0	12	143			
15	10862-66	4	2.1	4.4	2.9	3.7	2.64	54.0	51.8	1cb	10	1.0	10	114			
16	10866-72	6	2.0	2.0	2.8	2.4	2.68	53.1	50.9	2cb	35	1.0	35	94			
17	10872-76	4	13.9	7.1	14.7	10.9	2.595	50.5	58.3	3de	2.2	1.0	2.2	82			
18	10876-78	2	21.7	8.3	22.5	15.4	2.575	4.0	61.8	4de	1.4	1.0	1.4	73			
19	10878-82	4	18.6	6.9	19.4	13.2	2.59	0.9	58.7	4ce	1.8	1.0	1.8	75			
20	10882-85	3	24.0	11.0	24.8	17.9	2.53	31.8	61.6	4ce	1.2	1.0	1.2	68			
21	10885-88	3	22.0	8.5	22.8	15.7	2.57E	1.9	59.7	4ce	1.6	1.0	1.6	67			
22	10888-91	3	8.8	0.0	9.6	4.8	2.71	5.0	52.8	3cd	1.6	1.0	1.6	228			
23	10891-93	2	12.9	3.0	13.7	8.4	2.66	8.0	55.8	4ce	3.9	1.0	3.9	80			
24	10893-10900	7	1.9	-0.5	2.7	1.1	2.72	2.0	49.8	2cc	64	1.0	64	16.8K			
25	10900-08	8	7.2	1.4	8.0	4.7	2.69	6.1	53.9	3cd	6	1.0	6	116			
26	10908-13	5	1.0	-2.2	1.8	0.0	2.75	0.9	48.7	3cc	100	1.0	100	13.4K			
27	10913-15	2	1.7	1.9	2.5	2.2	2.68	53.0	50.8	2cb	90	1.0	90	64			
28	10915-19	4	0.7	-2.0	1.5	0.0	2.74	50.9	48.2	2cc	130	1.0	130	11.8K			
29	10919-23	4	3.3	0.1	4.1	2.1	2.71	53.2	51.0	2cc	8	1.0	8	225			
30	10923-25	2	2.3	-1.0	3.1	1.1	2.725	52.8	50.6	2cc	11	1.0	11	367			
31	10925-27	2	6.0	0.3	6.8	3.6	2.70	54.0	51.8	3cc	5.8	1.0	5.8	154			
32	10927-28	1	2.0	-1.1	2.8	0.9	2.725	51.8	49.6	2cc	30	1.0	30	172			
33	10928-29	1	0.7	0.8	1.5	1.2	2.70	51.5	49.3	2cb	30	1.0	30	204			
34	10929-31	2	0.6	-1.0	1.4	0.2	2.73	51.2	49.0	2cc	45	1.0	45	1.0K			
35	10931-33	2	0.4	0.0	1.2	0.6	2.715	50.8	48.6	2cb	45	1.0	45	333			
36	10933-36	3	0.8	-1.8	1.6	0.0	2.735	50.3	48.1	2cb	90	1.0	90	14.1K			
37	10936-40	4	1.8	1.0	2.6	1.8	2.695	52.3	50.1	2cb	15	1.0	15	192			

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Table E-24: Combined results of rock-typing and quantitative formation evaluation, Vera Strand #1-21-3C, zone 21-33M-56Z.

[illegible]

Table E-25: Combined results of rock-typing and quantitative formation evaluation, Holmgard #1-27, sesw 27-33N-56E.

Zone#	Depth	H	ØN	ØD	ØNc	Xplot Ø	Pb	Δt	Δtc	Code	Rt	CP	Rtc	Swt	DST	Perf.	By-passed OIP(MBO)
1	11261-68	7	-1.0	-10+	0.0	0.0	2.98	50.2	50.0	6Df	28K	1.0	28K	801	Yes		
2	11268-75	7	6.2	-3.6	7.2	1.8	2.77	47.4	47.2	4Bc	35	1.0	35	125	Yes		
3	11275-79	4	0.6	-10+	1.6	0.0	2.90	44.0	43.8	6Ac	205	1.0	205	9.4K	Yes		
4	11279-82	3	7.7	-4.2	8.7	2.3	2.78	49.5	49.3	4Bd	42	1.0	42	90	Yes		
5	11282-85	3	3.8	-10+	4.8	0.0	2.89	46.0	45.8	5Ad	100	1.0	100	13.4K	Yes		
6	11285-88	3	2.0	-7.3	3.0	0.0	2.83	44.5	44.3	4Ab	400	1.0	400	6.7K	Yes		
7	11288-92	4	4.5	-5.7	5.5	0.0	2.80	47.0	46.8	4Bc	120	1.0	120	12.2K	Yes		
8	11292-94	2	4.5	-7.7	5.5	0.0	2.835	47.0	46.8	4Bd	130	1.0	130	11.8K	Yes		
9	11294-96	2	7.4	-2.5	8.4	3.0	2.75	48.8	48.6	4Bc	20	1.0	20	99	Yes		
10	11296-98	2	5.9	-6.4	6.9	0.2	2.82	47.5	47.3	4Bd	80	1.0	80	749	Yes		
11	11298-11300	2	8.1	-2.8	9.1	3.2	2.75	48.0	47.8	4Ab	25	1.0	25	83	Yes		
12	11300-06	6	7.5	-4.5	8.5	2.0	2.785	47.9	47.7	4Bc	25	1.0	25	134	Yes		
13	11306-10	4	20.5	5.7	21.5	13.6	2.62	57.0	56.8	5Bd	1.5	1.0	1.5	80	Yes		
14	11310-12	2	1.0	0.5	2.0	1.3	2.70	51.0	50.8	2Cc	30	1.0	30	188	Yes		
15	11312-14	2	2.2	4.0	3.2	3.6	2.645	52.1	51.9	2Cb	30	1.0	30	64	Yes		
16	11314-16	2	1.1	-1.5	2.1	0.3	2.73	50.9	50.7	2Dc	70	1.0	70	534	Yes		
17	11316-20	4	2.2	2.0	3.2	2.6	2.67	52.8	52.6	2Dc	25	1.0	25	103	Yes		
18	11320-23	3	0.9	-1.7	1.9	0.1	2.735	50.9	50.7	2Dc	28	1.0	28	2.5K	Yes		
19	11323-25	2	5.1	1.5	6.1	3.8	2.68	53.0	52.8	2Dc	9	1.0	9	117			
20	11325-30	5	4.0	-1.2	5.0	1.9	2.73	53.0	52.8	3Dd	10	1.0	10	223			
21	11330-32	2	14.7	4.3	15.7	10.0	2.64	61.4	61.2	4Df	2.1	1.0	2.1	92			
22	11332-34	2	3.9	-1.0	4.9	2.0	2.725	51.5	51.3	3Cd	11	1.0	11	202			
23	11334-37	3	5.5	0.0	6.5	3.3	2.70	53.8	53.6	3Dd	8	1.0	8	143			
24	11337-40	3	1.6	-3.0	2.6	0.0	2.755	50.3	50.1	3Cd	49	1.0	49	19.2K			
25	11340-45	5	8.0	2.0	9.0	5.5	2.675	53.1	52.9	3Cc	42	1.0	42	295			
26	11345-46	1	1.3	-1.0	2.3	0.7	2.725	50.0	49.8	2Cc	23	1.0	23	32.5K			
27	11346-48	2	2.1	0.6	3.1	1.9	2.70	51.1	50.9	2Cc	15	1.0	15	182			
28	11348-51	3	2.0	-3.0	3.0	0.0	2.755	51.0	50.8	3Dd	17	1.0	17	32.5K			
29	11351-53	2	1.1	-2.0	2.1	0.1	2.745	50.0	49.8	2Cc	23	1.0	23	2.8K			
30	11353-54	1	0.6	-5.8	1.6	0.0	2.80	49.0	48.8	4Cd	200	1.0	200	9.5K			
31	11354-56	2	1.2	-0.9	2.2	0.7	2.72	51.0	50.8	2Dc	90	1.0	90	202			
32	11356-58	2	0.5	-2.0	1.5	0.0	2.74	49.7	49.5	2Cc	130	1.0	130	11.8K			
33	11358-60	2	2.0	-1.4	3.0	0.8	2.73	51.0	50.8	2Dc	13	1.0	13	465			
34	11360-62	2	1.8	-3.1	2.8	0.0	2.76	50.5	50.3	3Dd	20	1.0	20	30.0K			
35	11362-64	2	3.6	-1.7	4.6	1.5	2.74	52.0	51.8	3Dd	10	1.0	10	282			
36	11364-66	2	0.4	-3.2	1.4	0.0	2.76	49.3	49.1	3Cc	50	1.0	50	19.0K			
37	11366-68	2	0.3	0.3	1.3	0.8	2.70	49.4	49.2	2Cb	48	1.0	48	242			
38	11368-70	2	0.0	-2.6	1.0	0.0	2.75	49.0	48.8	3Cc	100	1.0	100	13.4K			
39	11370-73	3	0.7	-0.7	1.7	0.5	2.72	50.1	49.9	2Cc	40	1.0	40	424			
40	11373-75	3	1.0	-4.7	2.0	0.0	2.785	50.1	49.9	3Cd	30	1.0	30	24.5K			
41	11375-78	3	1.1	-1.0	2.1	0.6	2.725	50.0	49.8	2Cc	22	1.0	22	476			
42	11378-80	2	3.0	0.0	4.1	2.1	2.71	51.7	51.5	2Dc	10.5	1.0	10.5	197			
43	11380-82	2	1.0	-4.3	2.0	0.0	2.78	50.0	49.8	3Cd	24	1.0	24	27.4K			
44	11382-84	2	1.0	-2.7	2.0	0.0	2.75	50.5	50.3	3Dd	20	1.0	20	30.0K			
45	11384-86	2	0.9	-4.0	1.9	0.0	2.77	50.0	49.8	3Cd	35	1.0	35	22.7K			
46	11386-88	2	4.0	0.0	5.0	2.5	2.70	52.2	52.0	2Dc	9	1.0	9	178			
47	11388-90	2	1.3	-3.0	2.3	0.0	2.755	50.6	50.4	3Dd	20	1.0	20	30.0K			
48	11390-92	2	1.9	1.7	2.9	2.3	2.685	51.7	51.5	2Cc	16	1.0	16	145			
49	11392-94	2	1.8	-3.8	2.8	0.0	2.74	51.3	51.1	2Dd	20	1.0	20	30.0K			
50	11394-95	1	1.7	0.2	2.7	1.5	2.70	51.0	50.8	2Cc	19	1.0	19	205			
51	11395-97	2	1.7	-1.0	2.7	0.9	2.73	50.9	50.7	2Dc	23	1.0	23	310			
52	11397-98	1	0.9	-2.3	1.9	0.0	2.75	50.3	50.1	3Dc	30	1.0	30	24.5K			
53	11398-11400	2	0.7	-0.4	1.7	0.7	2.72	50.3	50.1	2Cc	29	1.0	29	355			
54	11400-02	2	0.6	-2.0	1.6	0.0	2.75	50.2	50.0	3Dc	30	1.0	30	24.5K			
55	11402-05	3	0.8	0.0	1.8	0.9	2.715	50.3	50.1	2Cc	28	1.0	28	281			
56	11405-10	5	1.2	-2.4	2.2	0.0	2.75	51.0	50.8	3Dd	20	1.0	20	30.0K			
57	11410-12	2	1.2	0.0	2.2	1.1	2.71	51.4	51.2	2Dc	14	1.0	14	325			

Table E-26: Combined results of rock-typing and quantitative formation evaluation, Williams #1-34, sesw 34-33N-56E.

Zone#	Depth	H	ϕ_N	ϕ_D	ϕ_{NC}	Xplot ϕ	Pb	Δt	Δt_c	Code	Rt	CP	Rtc	Sw ϕ	DST	Perf.	By-passed OIP(MBO)
1	11275-84	9	-1.0	-10+	0.0	0.0	2.98	50.9	50.0	6Df	13K	1.0	13K	1.2K	Yes		
2	11284-87	3	10.0	-1.4	11.0	4.8	2.75	49.5	48.6	4Ab	17	1.0	17	67	Yes		
3	11287-91	4	9.5	-5.8	10.5	2.4	2.80	49.1	48.2	4Bd	24	1.0	24	114	Yes	Yes	
4	11291-94	3	27.0	11.5	28.0	19.8	2.52	63.4	62.5	5Ce	4.4	1.0	4.4	32	Yes	Yes	
5	11294-96	2	14.8	5.5	15.8	10.7	2.625	62.0	61.1	4Df	8	1.0	8	44	Yes	Yes	
6	11296-97	1	27.1	12.7	28.1	20.4	2.50	62.5	61.6	5Bd	8	1.0	8	23	Yes	Yes	
7	11297-99	2	24.2	11.5	25.2	18.4	2.52	62.5	61.6	4Ce	9	1.0	9	24	Yes	Yes	
8	11299-11300	1	27.7	13.7	28.7	21.2	2.50	64.0	63.1	5Ce	8	1.0	8	22	Yes	Yes	
9	11300-01	1	20.6	7.0	21.6	14.3	2.60	59.9	59.0	5Ce	11	1.0	11	28			767
10	11301-03	2	25.1	11.1	26.1	18.6	2.53	62.0	61.1	5Ce	2	1.0	2	51			
11	11303-04	1	16.6	0.8	17.6	9.2	2.70	55.4	54.5	5Ce	3.4	1.0	3.4	79			
12	11304-06	2	19.0	8.0	20.0	14.0	2.585	56.0	55.1	4Ac	3.4	1.0	3.4	51			
13	11306-08	2	11.9	1.2	12.9	7.1	2.69	51.0	50.1	4Ab	10.3	1.0	10.3	58			
14	11308-10	2	17.0	3.1	18.0	10.6	2.66	52.0	51.1	4Ab	3.4	1.0	3.4	68			
15	11310-13	3	16.0	0.9	17.0	9.0	2.70	52.0	51.1	5Ac	5.8	1.0	5.8	61			
16	11313-16	3	18.2	6.8	19.2	13.0	2.60	57.4	56.5	4Bd	3.6	1.0	3.6	54			
17	11316-18	2	12.9	-3.0	13.9	5.5	2.76	51.0	50.1	5Bd	20	1.0	20	54			
18	11318-20	2	12.9	0.8	13.9	7.4	2.705	51.1	50.2	4Ac	20	1.0	20	40			331
19	11320-24	4	0.8	-1.7	1.8	0.1	2.74	49.9	49.0	2Cc	80	1.0	80	1.5K			
20	11324-25	1	8.1	2.4	9.1	5.8	2.67	52.1	51.2	3Bb	7	1.0	7	87			
21	11325-27	2	2.0	1.9	3.0	2.5	2.69	52.0	51.1	2Cc	20	1.0	20	54			
22	11327-29	2	2.4	6.5	3.4	5.0	2.60	53.4	52.5	1Cb	15	1.0	15	69			
23	11329-34	5	1.2	1.3	2.2	1.8	2.69	53.0	52.1	2Dc	20	1.0	20	166			
24	11334-37	3	2.8	6.0	3.8	4.9	2.615	54.0	53.1	1Cb	10.5	1.0	10.5	84			
25	11337-40	3	5.1	3.1	6.1	4.6	2.66	54.0	53.1	2Cc	6.2	1.0	6.2	117			
26	11340-42	2	10.1	6.2	11.1	8.7	2.60	55.8	54.9	2Cc	3	1.0	3	89			
27	11342-44	2	3.2	1.0	4.2	2.6	2.70	53.0	52.1	2Dc	8	1.0	8	182			
28	11344-47	3	10.0	3.1	11.0	7.1	2.66	57.1	56.2	3Dc	2.3	1.0	2.3	124			
29	11347-50	3	2.3	-0.6	3.3	1.4	2.72	50.9	50.0	2Cc	15	1.0	15	247			
30	11350-53	3	3.3	2.0	4.3	3.2	2.675	52.0	51.1	2Cd	8	1.0	8	148			
31	11353-56	3	1.1	0.0	2.1	1.1	2.71	51.2	50.3	2Cc	48	1.0	48	176			
32	11356-59	3	3.8	1.1	4.8	3.0	2.69	52.3	51.4	2Cc	10	1.0	10	141			
33	11359-61	2	2.0	-0.9	3.0	1.1	2.725	52.0	51.1	2Dc	18	1.0	18	287			
34	11361-63	2	1.9	2.0	2.9	2.5	2.68	52.0	51.1	2Cc	14	1.0	14	143			
35	11363-64	1	1.0	0.0	2.0	1.0	2.71	50.5	49.6	2Cb	6	1.0	6	547			
36	11364-66	2	1.5	1.4	2.5	2.0	2.685	51.1	50.2	2Cb	37	1.0	37	110			
37	11366-68	2	1.0	0.8	2.0	1.4	2.70	51.0	50.1	2Cb	50	1.0	50	135			
38	11368-70	2	2.0	2.0	3.0	2.5	2.68	51.2	50.3	2Cb	13	1.0	13	148			
39	11370-74	4	1.0	-2.5	2.0	0.0	2.75	50.0	49.1	3Cc	36	1.0	36	22.3K			
40	11374-76	2	1.0	1.2	2.0	1.6	2.685	50.7	49.8	2Cb	30	1.0	30	153			
41	11376-80	4	0.6	-0.8	1.6	0.4	2.725	50.0	49.1	2Cb	80	1.0	80	374			
42	11380-85	5	0.8	2.9	1.8	2.4	2.67	52.0	51.1	2Cb	50	1.0	50	79			
43	11385-89	4	0.6	-3.1	1.6	0.0	2.76	49.5	48.6	3Cc	95	1.0	95	13.8K			

Table E-27. Combined results of rock-typing and quantitative formation evaluation, Sun Sundsted #1, new 6-33N-57E.

Zone#	Depth	H	ΦN	ΦD	ΦNc	Xplot	Φ	Pb	Δt	Δtc	Code	Rt	CF	Rtc	Sw%	DST	Perf.	By-passed Reserve OIP(MBO)
1	11200-08	8	-1.0	-10+	0.0	0.0	0.0	2.97	50.1	50.0	6Df	5000	0.82	4100	2095			
2	11208-12	4	12.0	-0.9	13.0	6.1	2.725	49.1	49.0	4Ab	24	24	0.82	19.7	49	Yes		617.2
3	11212-15	3	6.8	-5.4	7.8	1.2	2.80	44.5	44.0	4Ab	80	80	0.82	65.6	138	Yes		
4	11215-17	2	23.6	11.0	24.6	17.8	2.53	60.1	60.0	4Bd	1.8	1.8	0.82	1.5	61	Yes		
5	11217-20	3	19.4	9.5	20.4	15.0	2.56	57.7	57.6	4Bc	4.0	4.0	0.82	3.3	49	Yes		
6	11220-24	4	29.0	14.0	30.0	22.0	2.49	66.3	66.2	5Df	3.2	3.2	0.82	2.6	37	Yes		
7	11224-30	6	7.2	-4.3	8.2	2.0	2.785	47.8	47.7	4Bc	34	34	0.82	27.9	127			
8	11230-33	3	24.0	8.1	25.0	16.6	2.58	56.9	56.8	5Ac	10.3	10.3	0.82	8.5	27	Yes		
9	11233-36	3	12.9	0.7	13.9	7.3	2.70	53.7	53.6	4Cd	50	50	0.82	41.0	28	Yes		
10	11236-39	3	18.4	6.0	19.4	12.7	2.61	55.8	55.7	4Bc	24	24	0.82	19.7	23	Yes		
11	11239-43	4	4.0	-1.1	5.0	2.0	2.73	49.5	49.4	3Cc	20	20	0.82	16.4	165			
12	11243-44.5	1.5	8.4	2.5	9.4	6.0	2.67	52.0	51.9	3Bc	10	10	0.82	8.2	78			
13	11244.5-48	3.5	2.0	0.7	3.0	1.9	2.70	49.9	49.8	2Cb	50	50	0.82	41.0	110			
14	11248-54	6	3.2	4.0	4.2	4.1	2.645	54.0	51.9	2Cb	31	31	0.82	25.4	64			
15	11254-57	3	2.0	-1.2	3.0	0.9	2.73	49.3	49.7	2Cc	130	130	0.82	106.6	144			
16	11257-59	2	3.5	2.0	4.5	3.3	2.67	50.4	50.3	2Cb	60	60	0.82	49.2	57			
17	11259-62	3	2.0	-1.0	3.0	1.0	2.72	59.6	49.5	2Cc	100	100	0.82	82.0	148			
18	11262-66	4	20.0	10.1	21.0	15.6	2.545	62.5	62.4	4Df	2.9	2.9	0.82	2.4	55	Yes		
19	11266-69	3	17.0	8.0	18.0	13.0	2.58	59.0	58.9	4Ce	3.0	3.0	0.82	2.5	65	Yes		
20	11269-72	3	25.3	9.2	26.3	17.8	2.56	62.1	62.0	5Cf	2.0	2.0	0.82	1.6	59	Yes		
21	11272-75	3	11.5	2.1	12.5	7.3	2.675	55.1	55.0	3Cd	6.0	6.0	0.82	4.9	83			
22	11275-77	2	11.7	2.1	12.7	7.4	2.675	56.0	55.9	4De	6.0	6.0	0.82	4.9	81			
23	11277-81	4	2.1	-0.1	3.1	1.5	2.71	51.5	51.4	2Dc	70	70	0.82	57.4	118			
24	11281-83	2	6.7	1.4	7.7	4.6	2.685	53.3	53.2	3Dd	10.9	10.9	0.82	8.9	97			
25	11283-86	3	1.5	-2.0	2.5	0.3	2.74	50.8	50.7	2Dd	270	270	0.82	221.4	300			
26	11286-88	2	2.3	0.2	3.3	1.8	2.70	51.3	51.2	2Cc	80	80	0.82	65.6	92			
27	11288-90	2	2.3	-2.0	3.3	0.7	2.735	50.0	49.9	2Cc	140	140	0.82	114.8	178			
28	11290-97	7	9.4	0.0	10.4	5.2	2.71	52.6	52.5	3Cd	11	11	0.82	9.0	86			
29	11297-11302	5	1.8	-3.3	2.8	0.0	2.755	48.0	47.9	3Bc	210	210	0.82	172.2	10223			351.1
30	11302-06	4	4.0	1.7	5.0	3.4	2.68	52.0	51.9	2Cc	80	80	0.82	65.6	48			
31	11306-11	5	2.0	-1.0	3.0	1.0	2.72	49.8	49.7	2Cc	120	120	0.82	98.4	135			
32	11311-14	3	19.2	8.8	20.2	14.5	2.565	60.4	60.3	4De	3.0	3.0	0.82	2.5	58	Yes		
33	11314-17	3	14.2	2.5	15.2	8.9	2.66	56.0	55.9	4Ce	4.0	4.0	0.82	3.3	82	Yes		
34	11317-20	3	1.1	-2.0	2.1	0.1	2.74	48.0	47.9	2Bb	100	100	0.82	82.0	1481			
35	11320-23	3	1.0	0.0	2.0	1.0	2.71	48.5	48.4	2Bb	90	90	0.82	73.8	156			
36	11323-24.5	1.5	0.9	-1.9	1.9	0.0	2.74	48.0	47.9	2Bb	210	210	0.82	172.2	10223			
37	11324.5-27	2.5	1.1	-0.4	2.1	0.9	2.715	49.5	49.4	2Cb	110	110	0.82	90.2	156			
38	11327-35.5	8.5	1.8	-2.2	2.8	0.3	2.75	49.0	48.9	3Cc	40	40	0.82	32.8	780			
39	11335.5-38	2.5	4.0	-0.5	5.0	2.3	2.72	50.4	50.3	3Cc	14	14	0.82	11.5	172			
40	11338-41	3	1.5	-1.0	2.5	0.8	2.725	48.9	48.8	2Cb	43	43	0.82	35.3	282			
41	11341-46	5	1.0	-4.1	2.0	0.0	2.78	48.3	48.2	3Cc	70	70	0.82	57.4	17708			

Table E-28: Combined results of rock-typing and quantitative formation evaluation, Astrup #1, snw 11-33N-57E.

Zone#	Depth	H	ϕ_N	ϕ_D	ϕ_{Mc}	Xplot	ϕ	Pb	Δt	Δt_c	Code	Rt	CF	Rtc	Swt	DST	Perf.	By-passed OIP(MBO)
1	11190-99	9	-1.0	-10+	0.0	0.0	0.0	2.99	50.8	50.0	6Df	50K	1.0	50K	599			
2	11199-11203	4	4.3	-2.8	5.3	1.3	1.3	2.79	47.2	46.4	4AC	50	1.0	50	145			
3	11203-17	14	0.9	-9.6	1.9	0.0	0.0	2.87	44.0	43.2	5AC	1.3K	1.0	1.3K	3.7K			
4	11217-19	2	3.8	-5.2	4.8	0.0	0.0	2.795	46.7	45.9	3AB	500	1.0	500	6.0K			
5	11219-22	3	3.3	-7.5	4.3	0.0	0.0	2.83	46.1	45.3	4AC	500	1.0	500	6.0K			
6	11222-25	3	11.9	-2.2	12.9	5.4	2.75	50.0	49.2	4AC	9	9	1.0	9	82			
7	11225-27	2	5.9	-7.2	6.9	0.0	0.0	2.825	47.0	46.2	4BC	100	1.0	100	13.4K			
8	11227-31	4	10.1	-3.3	11.1	3.9	2.765	49.7	48.9	4BC	8	8	1.0	8	121			
9	11231-36	5	18.2	3.0	19.2	11.1	2.67	55.8	55.0	5Bd	2.8	2.8	1.0	2.8	72			
10	11236-38	2	3.2	0.7	4.2	2.5	2.70	51.2	50.4	2Cc	10.7	10.7	1.0	10.7	164			
11	11238-41	3	2.5	2.1	3.5	2.8	2.675	52.0	51.2	2Cb	10.6	10.6	1.0	10.6	147			
12	11241-45	4	1.9	-0.2	2.9	1.4	2.715	51.1	50.3	2Cc	45	45	1.0	45	142			
13	11245-49	4	2.0	2.0	3.0	2.5	2.675	52.0	51.2	2Cb	20	20	1.0	20	120			
14	11249-52	3	2.0	-3.1	3.0	0.0	2.73	51.5	50.7	2Dc	46	46	1.0	46	19.8K			
15	11252-56	4	16.5	5.0	17.5	11.3	2.635	60.0	59.2	4Df	2.1	2.1	1.0	2.1	81			
16	11256-60	4	14.7	2.9	15.7	9.3	2.66	58.0	57.2	4De	3	3	1.0	3	83			
17	11260-64	4	29.4	12.0	30.4	21.2	2.52	64.5	63.7	6Cf	1.1	1.1	1.0	1.1	60			
18	11264-67	3	13.1	-0.8	14.1	6.7	2.72	56.2	55.4	4Df	3.8	3.8	1.0	3.8	102			
19	11267-69	2	14.3	0.2	15.3	7.8	2.70	56.7	55.9	4Df	3.8	3.8	1.0	3.8	88			
20	11269-71	2	2.9	-2.0	3.9	1.0	2.74	52.0	51.2	3Dd	50	50	1.0	50	189			
21	11271-72	1	10.1	0.5	11.1	5.8	2.70	56.0	55.2	4Ce	7	7	1.0	7	62			
22	11272-74	2	6.4	-0.8	7.4	3.3	2.725	52.0	51.2	3Cd	14	14	1.0	14	108			
23	11274-77	3	7.6	0.6	8.6	4.6	2.70	52.4	51.6	3Cc	14	14	1.0	14	77			
24	11277-82	5	2.7	-2.3	3.7	0.7	2.75	51.0	50.2	3Cd	40	40	1.0	40	303			
25	11282-83	1	6.9	-1.7	7.9	3.1	2.74	53.1	52.3	3Dd	9	9	1.0	9	144			
26	11283-85	2	5.7	-2.3	6.7	2.2	2.75	52.8	52.0	3Dd	10	10	1.0	10	192			
27	11285-88	3	6.0	-0.2	7.0	3.4	2.72	53.2	52.4	3Dd	8	8	1.0	8	139			
28	11288-94	6	1.7	-3.3	2.7	0.0	2.76	50.0	49.2	3Cc	130	130	1.0	130	11.8K			
29	11294-96	2	2.2	0.6	3.2	1.9	2.70	55.0	54.2	2De	39	39	1.0	39	113			
30	11296-98	2	2.2	-1.6	3.2	0.8	2.74	52.2	51.4	3Dd	200	200	1.0	200	118			
31	11298-11300	2	4.8	-0.1	5.8	2.9	2.715	56.8	56.0	3Df	22	22	1.0	22	98			
32	11300-03	3	2.0	-3.5	3.0	0.0	2.77	50.2	49.4	3Cd	68	68	1.0	68	16.3K			
33	11303-06	3	9.5	-2.8	10.5	3.9	2.74	54.5	53.7	4De	3.3	3.3	1.0	3.3	189			
34	11306-08	2	6.6	-4.0	7.6	1.8	2.77	53.7	52.9	4De	5	5	1.0	5	333			
35	11308-09	1	6.8	-2.0	7.8	2.9	2.745	53.8	53.0	3De	4.7	4.7	1.0	4.7	213			
36	11309-11	2	1.0	-2.4	2.0	0.0	2.745	49.5	48.7	2Cc	50	50	1.0	50	19.0K			
37	11311-14	3	1.0	-0.3	2.0	0.9	2.72	49.9	49.1	2Cb	50	50	1.0	50	210			
38	11314-16	2	1.0	-4.8	2.0	0.0	2.79	49.1	48.3	3Cc	70	70	1.0	70	16.0K			
39	11316-19	3	2.0	-3.0	3.0	0.0	2.76	50.3	49.5	3Cc	27	27	1.0	27	25.8K			
40	11319-21	2	2.0	-0.4	3.0	1.3	2.72	51.0	50.2	2Cc	24	24	1.0	24	210			
41	11321-25	4	2.0	-2.9	3.0	0.1	2.75	50.0	49.8	3Cc	21	21	1.0	21	2.9K			
42	11325-28	3	2.5	-1.7	3.5	0.9	2.74	51.4	50.6	3Dd	11	11	1.0	11	449			
43	11328-31	3	1.6	-3.4	2.6	0.0	2.765	50.8	50.0	3Dd	26	26	1.0	26	26.3K			

Table E-29: Combined results of rock-typing and quantitative formation evaluation, Madsen #1-17, snw 17-33N-57E.

Zone#	Depth	H	ρ _m	ρ _{DC}	Xplot	ρ	Δt	Δtc	Code	Rt	CP	Rtc	Sw4	DST	Perf.	By-passed OIP (MMB)
1	11227-36	9	-0.9	-10+	0.0	0.0	2.96	51.2	50.0	6DF	13K	0.93	12K	12.2K		
2	11236-39	3	5.5	-3.0	6.4	1.7	2.755	47.0	45.8	3AB	50	0.93	46.5	11.5		
3	11239-44	5	5.8	-6.5	6.7	0.1	2.81	48.0	46.8	4BC	40	0.93	37.2	21.2K		
4	11244-52	8	0.6	-8.8	1.5	0.0	2.85	44.0	42.8	5AB	600	0.93	558.0	5.7K		
5	11252-55	3	4.3	-5.2	5.2	0.0	2.795	45.2	44.0	3AB	210	0.93	195.3	9.6K		
6	11255-57	2	1.5	-6.6	2.4	0.0	2.815	44.4	43.2	4AB	300	0.93	279.0	8.0K		
7	11257-61	4	4.0	-3.2	4.9	0.9	2.76	46.9	45.7	3AB	500	0.93	465.0	69		
8	11261-65	4	3.5	-6.4	4.4	0.0	2.81	46.0	44.8	4AB	110	0.93	102.3	13.3K	Yes	
9	11265-70	5	9.5	-2.6	10.4	3.9	2.75	48.0	46.8	4AB	15	0.93	14.0	91	Yes	
10	11270-74	4	11.3	1.8	12.2	7.0	2.685	50.0	48.8	4AB	10	0.93	9.3	62	Yes	
11	11274-76	2	22.5	6.7	23.4	15.1	2.60	55.4	54.2	5AB	3	0.93	2.8	53	Yes	
12	11276-78	2	18.0	3.0	18.9	11.0	2.66	54.2	53.0	5AC	3.3	0.93	3.1	69	Yes	
13	11278-81	4	22.9	7.1	23.8	15.5	2.595	56.3	55.1	5AC	2.5	0.93	2.3	57	Yes	
14	11281-82	1	17.8	4.0	18.7	11.4	2.645	56.3	55.1	4BA	4	0.93	3.7	61	Yes	
15	11282-84	2	23.0	5.3	23.9	14.6	2.625	56.7	55.5	5BA	2.4	0.93	2.2	61	Yes	
16	11284-85	4	21.6	7.8	22.5	15.2	2.635	56.0	54.8	4BC	2.6	0.93	2.4	75	Yes	
17	11285-89	4	21.6	7.8	22.5	15.2	2.59	57.2	56.0	5AC	2	0.93	1.9	64	Yes	
18	11289-91	2	19.9	3.7	20.8	12.3	2.65	56.4	55.2	5BA	3	0.93	2.8	65	Yes	
19	11291-92	1	24.0	4.9	24.9	14.9	2.63	56.4	55.2	5BA	3	0.93	3.3	49	Yes	
20	11292-97	5	14.4	-0.3	15.3	7.5	2.715	54.9	53.7	4C	10.5	0.93	9.8	57	Yes	
21	11297-98	1	12.7	-4.0	13.6	4.8	2.765	52.0	50.8	4BA	10	0.93	9.3	91	Yes	
22	11298-11300	1	16.0	1.0	16.9	9.0	2.70	52.0	50.8	5AC	10	0.93	9.3	70	Yes	
23	11300-01	1	12.0	-0.5	12.9	6.2	2.72	50.9	49.7	4AB	9	0.93	8.4	53	Yes	
24	11301-03	2	14.3	2.0	15.2	8.6	2.68	50.8	49.6	4AB	9	0.93	8.4	53	Yes	
25	11303-04	4	16.0	-1.0	16.9	8.0	2.625	50.7	49.5	5AC	8.8	0.93	8.7	58	Yes	
26	11304-08	4	19.1	3.0	20.0	12.0	2.66	54.0	52.8	5AC	5	0.93	4.7	51	Yes	
27	11308-10	2	17.1	-1.0	18.0	8.5	2.725	53.0	51.8	5BA	5	0.93	4.7	72	Yes	
28	11310-11	1	17.9	1.1	18.8	10.0	2.69	56.6	55.4	5C	5	0.93	4.7	61	Yes	
29	11311-14	3	11.8	0.4	12.7	6.6	2.70	51.9	50.7	4BC	9	0.93	8.4	70	Yes	
30	11314-25	11	22.0	8.0	22.9	15.5	2.585	60.3	59.1	5C	2	0.93	1.9	62	Yes	
31	11325-28	3	13.0	0.0	13.9	7.0	2.705	53.7	52.5	4BA	16	0.93	14.9	29	Yes	
32	11328-30	2	21.5	10.1	22.4	16.3	2.545	60.0	58.8	4BA	10	0.93	9.3	26	Yes	
33	11330-32	2	18.0	5.4	18.9	12.2	2.625	58.8	57.6	4C	15	0.93	14.0	29	Yes	
34	11332-35	3	30.3	12.1	31.2	21.7	2.51	66.0	64.8	5C	1.2	0.93	1.1	58	Yes	
35	11335-38	3	19.4	7.2	20.3	13.8	2.595	57.8	56.6	4BA	2	0.93	1.9	70	Yes	
36	11338-40	2	25.8	11.2	26.7	19.0	2.525	64.8	63.6	5DF	1.3	0.93	1.2	64	Yes	
37	11340-44	4	23.0	5.5	23.9	14.7	2.62	58.1	56.9	5BA	2.0	0.93	1.9	66	Yes	
38	11344-48	4	20.9	10.2	21.8	16.0	2.545	63.4	62.2	4DF	1.1	0.93	1.0	83	Yes	
39	11348-53	5	10.6	-0.8	11.5	5.4	2.72	53.8	52.6	4C	6	0.93	5.6	104	Yes	
40	11353-56	3	22.8	10.3	23.7	17.0	2.54	65.0	63.8	4DF	1	0.93	0.9	81	Yes	
41	11356-58	2	21.1	8.8	22.0	15.4	2.57	67.4	66.2	4DF	1.2	0.93	1.1	83	Yes	
42	11358-60	2	25.4	10.4	26.3	18.4	2.54	65.2	64.0	5DF	1	0.93	0.9	75	Yes	
43	11360-62	2	23.2	8.0	24.1	16.1	2.58	61.5	60.3	5C	1	0.93	0.9	86	Yes	
44	11362-63	1	25.6	12.0	26.5	19.3	2.515	65.6	64.4	5DF	1.1	0.93	1.0	69	Yes	
45	11363-65	2	22.0	9.8	22.9	16.4	2.555	66.1	64.9	4DF	1.3	0.93	1.2	74	Yes	
46	11365-70	3	15.0	2.0	15.9	9.0	2.68	58.5	57.3	4DF	2.7	0.93	2.5	94	Yes	
47	11370-73	3	16.0	5.9	16.9	11.4	2.615	58.5	57.3	4C	2.7	0.93	2.5	74	Yes	
48	11373-75	2	14.3	4.5	15.2	10.0	2.635	58.3	57.1	4DF	3	0.93	2.8	80	Yes	
49	11375-77	2	18.8	7.8	19.7	13.8	2.585	62.0	60.8	4DF	1.5	0.93	1.4	82	Yes	
50	11377-80	3	10.2	0.0	11.1	5.6	2.71	57.1	55.9	4DF	3.1	0.93	2.9	140	Yes	
51	11380-84	4	11.5	5.7	12.4	9.1	2.62	58.3	56.1	3C	2.4	0.93	2.2	99	Yes	
52	11384-87	3	5.7	1.0	6.6	3.8	2.70	55.5	54.3	3De	4	0.93	3.7	183	Yes	
53	11387-90	3	8.7	4.6	9.6	7.1	2.635	56.1	54.9	3C	3.8	0.93	3.5	101	Yes	
54	11390-93	3	6.0	2.1	6.9	4.5	2.675	52.8	51.6	2C	7	0.93	6.5	116	Yes	
55	11393-96	3	9.2	3.5	10.1	6.8	2.65	54.4	53.2	3C	5	0.93	4.7	91	Yes	
56	11396-99	5	3.0	-0.3	3.9	1.8	2.72	52.0	50.8	2C	11	0.93	10.2	233	Yes	
57	11399-11404	4	3.2	2.8	4.1	3.5	2.655	53.0	51.8	2C	10	0.93	9.3	125	Yes	
58	11404-08	4	1.6	-1.7	2.5	0.4	2.735	51.9	50.7	2De	15	0.93	14.0	896	Yes	
59	11408-12	4	4.0	3.3	4.9	4.1	2.65	53.8	52.6	2C	7	0.93	6.5	126	Yes	
60	11412-15	3	4.5	1.1	5.4	3.3	2.70	53.0	51.8	3C	9	0.93	8.4	140	Yes	

Table E-30: Combined results of rock-typing and quantitative formation evaluation, Grotokurth Petersen #1-21, ssnw 21-33W-57E.

Zone#	Depth	H	SW	SD	SWC	Xplot	Pb	Δt	Δtc	Code	Rt	CF	Rtc	Swf	DST	Perf.	By-passed OIP(MBO)
1	11147-56	9	-1.0	-10+	0.0	0.0	2.99	50.5	50.0	60f	50K	1.0	50K	599			
2	11156-62	6	3.7	-4.8	4.7	0.0	2.79	47.0	46.5	38c	140	1.0	140	11.3K			
3	11162-66	4	0.7	-10+	1.7	0.0	2.87	44.0	43.5	53c	900	1.0	900	4.5K			
4	11166-70	4	8.0	-6.0	9.0	1.5	2.81	49.5	49.0	48d	43	1.0	43	136			
5	11170-73	3	0.9	-9.5	1.9	0.0	2.86	43.8	43.3	53b	2.0K	1.0	2.0K	3.0K			
6	11173-75	2	3.0	-7.5	4.0	0.0	2.83	45.5	45.0	43c	200	1.0	200	9.5K			
7	11175-80	5	2.0	-10+	3.0	0.0	2.89	46.0	45.5	53d	1.9K	1.0	1.9K	3.1K			
8	11180-83	3	8.5	-2.0	9.5	3.8	2.75	50.6	50.1	48c	170	1.0	170	27			413
9	11183-87	4	3.2	-8.0	4.2	0.0	2.84	46.9	46.4	48b	300	1.0	300	7.7K			
10	11187-92	5	10.8	0.0	11.8	5.9	2.70	49.4	48.9	48b	15	1.0	15	58			
11	11192-94	2	12.9	2.0	13.9	8.0	2.68	52.0	51.5	48c	12	1.0	12	48			
12	11194-98	4	0.0	-4.6	1.0	0.0	2.79	49.8	49.3	30d	250	1.0	250	8.5K			
13	11198-11202	4	1.0	1.0	2.0	1.5	2.70	51.6	51.1	20c	180	1.0	180	66			
14	11202-03	1	1.0	-2.3	2.0	0.0	2.75	50.0	49.5	30c	500	1.0	500	6.0K			
15	11203-05	2	1.1	0.8	2.1	1.5	2.70	51.7	51.2	20c	60	1.0	60	115			
16	11205-07	2	0.7	-4.0	1.7	0.0	2.77	50.0	49.5	30d	60	1.0	60	17.3K			
17	11207-12	5	8.7	2.5	9.7	6.1	2.57	54.1	53.6	30d	19	1.0	19	50			
18	11212-18	6	21.5	8.7	22.5	15.6	2.57	62.5	62.0	40f	15	1.0	15	22			
19	11218-22	4	3.6	-5.2	4.6	0.0	2.80	49.9	49.4	40f	60	1.0	60	17.3K			
20	11222-24	2	4.4	-1.1	5.4	2.2	2.73	50.7	50.2	30c	50	1.0	50	86			
21	11224-25	1	2.2	-3.6	3.2	0.0	2.76	49.2	48.7	30c	305	1.0	305	7.7K			
22	11225-27	3	2.6	-2.0	3.6	0.8	2.74	50.1	49.6	30c	90	1.0	90	176			
23	11227-30	3	1.3	-4.0	2.3	0.0	2.77	49.0	48.5	30c	230	1.0	230	8.8K			
24	11230-32	2	1.5	-0.8	2.5	0.9	2.72	52.0	51.5	20d	180	1.0	180	111			
25	11232-33	1	1.5	-3.2	2.5	0.0	2.76	49.8	49.3	30c	400	1.0	400	6.7K			
26	11233-36	1	1.9	0.0	2.9	1.5	2.71	50.6	50.1	20d	110	1.0	110	85			
27	11236-41	5	0.8	-6.8	1.8	0.0	2.82	48.4	47.9	48d	1.1K	1.0	1.1K	4.0K			
28	11241-43	2	1.0	-4.7	2.0	0.0	2.78	49.5	49.0	30d	200	1.0	200	9.5K			
29	11243-45	2	0.9	-6.8	1.9	0.0	2.82	48.0	47.5	48d	600	1.0	600	5.5K			
30	11245-47	2	0.8	-2.9	1.8	0.0	2.75	49.0	48.5	30c	240	1.0	240	8.7K			
31	11247-50	3	0.9	-4.0	1.9	0.0	2.77	48.0	47.5	38c	800	1.0	800	4.7K			
32	11250-54	4	1.6	0.0	2.6	1.3	2.71	52.0	51.5	20c	100	1.0	100	103			
33	11254-57	3	0.5	-6.5	1.5	0.0	2.815	48.0	47.5	48d	100	1.0	100	13.4K			
34	11257-58	1	2.5	-3.0	3.5	0.3	2.76	50.0	49.5	30c	26	1.0	26	877			
35	11258-60	2	2.5	-4.6	3.5	0.0	2.785	50.0	49.5	30d	26	1.0	26	26.3K			
36	11260-64	4	7.0	-1.6	8.0	3.2	2.735	52.0	51.5	30d	15	1.0	15	108			
37	11264-68	4	0.0	-1.6	1.0	0.0	2.775	48.0	47.5	38c	400	1.0	400	6.7K			
38	11268-72	4	0.1	-2.0	1.1	0.0	2.74	49.0	48.5	38c	250	1.0	250	8.5K			
39	11272-74	2	0.1	-5.0	1.1	0.0	2.75	48.0	47.5	38c	300	1.0	300	7.7K			
40	11274-76	2	0.4	-3.0	1.4	0.0	2.755	48.2	47.7	38b	150	1.0	150	11.0K			
41	11276-80	4	0.3	-4.0	1.3	0.0	2.775	48.3	47.8	38c	160	1.0	160	10.6K			
42	11280-83	3	1.0	-0.9	2.0	0.6	2.72	49.0	48.5	20c	700	1.0	700	84			
43	11283-84	1	0.8	-5.3	1.8	0.0	2.795	48.7	48.2	30c	160	1.0	160	10.6K			
44	11284-86	2	0.7	-2.8	1.7	0.0	2.75	48.0	47.5	38b	130	1.0	130	11.8K			
45	11286-87	1	0.6	-5.5	1.6	0.0	2.795	48.1	47.6	38c	200	1.0	200	9.5K			
46	11287-89	2	0.5	-2.3	1.5	0.0	2.75	48.0	47.5	38b	200	1.0	200	9.5K			
47	11289-90	1	0.5	-5.8	1.5	0.0	2.80	48.1	47.6	48c	260	1.0	260	8.3K			
48	11290-91	1	0.4	-4.0	1.4	0.0	2.77	48.7	48.2	30c	70	1.0	70	16.0K			
49	11291-93	2	0.5	-6.2	1.5	0.0	2.81	48.7	48.2	40d	100	1.0	100	13.4K			
50	11293-97	4	2.0	-1.4	3.0	0.8	2.73	49.1	48.6	20c	60	1.0	60	216			
51	11297-99	2	1.3	-4.0	2.3	0.0	2.77	49.0	48.5	30c	120	1.0	120	12.2K			
52	11299-11301	2	2.0	-1.0	3.0	1.0	2.725	50.0	49.5	20c	60	1.0	60	173			
53	11301-02	1	1.3	-2.3	2.3	0.0	2.75	48.5	48.0	30c	140	1.0	140	11.3K			
54	11302-03	1	1.7	-0.7	2.7	1.0	2.72	49.0	48.5	20c	85	1.0	85	145			
55	11303-05	2	0.8	-2.2	1.8	0.0	2.745	49.0	48.5	20c	160	1.0	160	10.6K			
56	11305-07	2	1.0	0.9	2.0	1.5	2.69	49.0	48.5	28b	110	1.0	110	85			
57	11307-10	3	0.0	-4.0	1.0	0.0	2.77	48.6	48.1	30c	210	1.0	210	9.3K			
58	11310-13	3	0.1	-1.8	1.1	0.0	2.74	48.5	48.0	20c	220	1.0	220	8.0K			
59	11313-16	3	0.1	-5.4	1.1	0.0	2.80	48.4	47.9	48c	270	1.0	270	8.2K			
60	11316-20	4	0.3	-1.3	1.3	0.0	2.73	48.4	47.9	28b	200	1.0	200	9.5K			
61	11320-22	2	0.5	-4.9	1.5	0.0	2.79	48.4	47.9	38c	340	1.0	340	7.3K			

Table E-31: Combined results of rock-typing and quantitative formation evaluation, Patrick-Williams-Gulf, Miller #2, nws 28-33N-57E.

Zone#	Depth	H	ØN	ØD	ØMc	Xplot Ø	Pb	Δt	Δtc	Code	Rt	CF	Rtc	Swt	DST	Perf.	By-passed OIP(MBO)
1	11208-16	8	0.0	-10+	0.0	0.0	2.97	50.0	50.0	6Df	2K	1.0	2K	3.0K			
2	11216-22	6	12.0	-2.6	12.0	10.1	2.75	48.3	48.3	4Ac	15	1.0	15	67			
3	11222-27	5	8.0	-6.0	8.0	1.0	2.80	45.6	45.6	4Ab	101	1.0	101	133		Yes	
4	11227-32	5	30.0	12.9	30.0	21.5	2.50	76.0	76.0	5Df	6	1.0	6	25		Yes	
5	11232-35	3	16.0	-0.3	16.0	7.9	2.71	55.8	55.8	4Df	20	1.0	20	37		Yes	
6	11235-38	3	7.4	-8.2	7.4	0.0	2.84	46.8	46.8	4Bd	130	1.0	130	11.8K			
7	11238-42	4	14.9	-1.7	14.9	6.6	2.735	52.1	52.1	5Bd	40	1.0	40	32		Yes	
8	11242-43	1	21.9	1.8	21.9	11.9	2.69	55.0	55.0	6Be	22	1.0	22	24		Yes	
9	11243-45	2	18.0	-2.0	18.0	8.0	2.74	56.0	56.0	5Cf	30	1.0	30	30		Yes	
10	11245-48	3	22.4	7.7	22.4	15.1	2.62	59.0	59.0	5Cf	11	1.0	11	26		Yes	
11	11248-50	2	8.1	-4.4	8.1	1.9	2.77	50.0	50.0	4Cd	30	1.0	30	128		Yes	
12	11250-52	2	8.1	-1.3	8.1	3.4	2.725	51.0	51.0	3Cc	15	1.0	15	101			
13	11252-53	1	2.5	-3.9	2.5	0.0	2.765	48.5	48.5	3Cc	70	1.0	70	16.0K	Yes		
14	11253-55	2	6.4	-2.0	6.4	2.2	2.74	50.3	50.3	3Cc	21	1.0	21	132	Yes		
15	11255-63	8	2.0	1.0	2.0	1.5	2.695	51.4	51.4	2Dc	50	1.0	50	126	Yes		
16	11263-66	3	1.4	-2.8	1.4	0.0	2.75	50.3	50.3	3Cd	250	1.0	250	8.5K	Yes		
17	11266-68	2	2.7	-0.9	2.7	0.9	2.69	52.0	52.0	2Dc	50	1.0	50	210	Yes		
18	11268-71	3	1.3	-2.8	1.3	0.0	2.75	50.0	50.0	3Dc	110	1.0	110	12.8K			
19	11271-73	2	6.1	-0.2	6.1	3.0	2.705	52.5	52.5	3Dd	16	1.0	16	111			
20	11273-76	3	6.1	-1.5	6.1	2.3	2.72	51.1	51.1	3Cc	26	1.0	26	114			
21	11276-79	3	15.7	4.4	15.7	5.1	2.64	60.0	60.0	2Df	4	1.0	4	131			
22	11279-81	2	13.0	-3.2	13.0	4.9	2.76	56.7	56.7	4Df	8	1.0	8	96			
23	11281-84	3	14.0	3.8	14.0	8.9	2.65	57.3	57.3	4De	6	1.0	6	61			
24	11284-86	2	12.9	-2.4	12.9	5.3	2.74	54.2	54.2	4Df	7	1.0	7	95			
25	11286-87	1	13.6	0.0	13.6	6.8	2.71	54.2	54.2	4Ce	7	1.0	7	74			
26	11287-92	5	4.0	-6.8	4.0	0.0	2.81	50.7	50.7	4De	80	1.0	80	15.0K			
27	11292-95	3	6.6	0.0	6.6	3.3	2.715	50.9	50.9	3Cc	20	1.0	20	90			
28	11295-97	2	2.3	-4.8	2.3	0.0	2.78	49.9	49.9	3Cd	80	1.0	80	15.0K			
29	11297-99	2	4.7	-0.4	4.7	2.2	2.72	51.0	51.0	3Cd	30	1.0	30	111			
30	11299-11300	1	2.8	-4.5	2.8	0.0	2.785	50.0	50.0	3Dd	80	1.0	80	15.0K			
31	11300-01	1	4.3	-2.0	4.3	1.2	2.74	51.0	51.0	3Dd	20	1.0	20	374			
32	11301-03	2	5.0	-3.5	5.0	0.8	2.765	51.4	51.4	3Dd	11	1.0	11	149			
33	11303-06	3	7.0	-1.7	7.0	2.7	2.75	52.8	52.8	3De	11	1.0	11	300	7.7K		
34	11306-12	6	1.8	-7.1	1.8	0.0	2.815	49.7	49.7	4Ce	300	1.0	300	7.7K			
35	11312-14	2	2.6	-1.5	2.6	0.6	2.70	52.9	52.9	2Dd	100	1.0	100	223			
36	11314-15	1	2.0	-3.8	2.0	0.0	2.765	50.0	50.0	3Dd	370	1.0	370	7.0K			
37	11315-17	2	2.0	-1.0	2.0	0.5	2.725	52.3	52.3	2Dd	100	1.0	100	268			
38	11317-20	3	1.8	-4.5	1.8	0.0	2.78	48.6	48.6	3Cc	350	1.0	350	7.2K			
39	11320-24	4	6.8	-4.0	6.8	1.4	2.77	51.9	51.9	3De	14	1.0	14	256			
40	11324-27	3	8.0	-1.0	8.0	3.5	2.73	53.2	53.2	3De	11	1.0	11	115			
41	11327-29	2	1.6	-2.2	1.6	0.0	2.77	49.0	49.0	3Cc	120	1.0	120	12.2K			
42	11329-32	3	1.6	-3.0	1.6	0.0	2.75	49.3	49.3	3Cc	130	1.0	130	11.8K			
43	11332-36	4	1.6	-5.9	1.6	0.0	2.80	48.4	48.4	4Cd	190	1.0	190	9.7K			
44	11336-40	4	0.0	-0.8	0.0	0.0	2.72	49.0	49.0	2Cb	90	1.0	90	14.1K			
45	11340-43	3	2.1	-5.5	2.1	0.0	2.79	49.0	49.0	3Cd	70	1.0	70	16.0K			
46	11343-47	4	2.5	-1.7	2.5	0.4	2.73	50.0	50.0	2Cc	40	1.0	40	530			
47	11347-49	2	2.0	-2.4	2.0	0.0	2.78	48.9	48.9	3Cc	70	1.0	70	16.0K			
48	11349-52	3	2.3	-2.4	2.3	0.0	2.75	49.2	49.2	3Cc	50	1.0	50	19.0K			
49	11352-56	4	2.0	-7.1	2.0	0.0	2.82	48.6	48.6	4Cd	70	1.0	70	16.0K			
50	11356-60	4	0.0	-2.8	0.0	0.0	2.75	50.9	50.9	3Dd	75	1.0	75	15.5K			

Table E-33: Combined results of rock-typing and quantitative formation evaluation, Clear Lake #1-5, mmmw 5-33N-58E.

Zone#	Depth	H	ρ_H	ρ_D	ρ_{sc}	Xplot ϕ	Pb	Δt	Δt_c	Code	Rt	CF	Rtc	Swt	DST	Perf.	By-passed OIP(MBO)
1	11136-46	10	-1.0	-10+	0.0	0.0	2.99	50.0	50.0	6Df	27K	0.9	24.3K	860	Yes		
2	11146-50	4	11.0	-1.5	12.0	5.3	2.73	49.5	49.5	4Ac	12	0.9	10.8	77	Yes		
3	11150-54	4	7.8	-2.8	8.8	3.0	2.755	47.8	47.8	4Ab	20	0.9	18	105	Yes		
4	11154-56	2	28.0	15.8	29.0	22.4	2.465	66.0	66.0	5Df	2.7	0.9	2.4	38	Yes	Yes	
5	11156-59	3	25.0	13.2	26.0	19.6	2.50	63.1	63.1	4Cc	6	0.9	5.4	29	Yes	Yes	
6	11159-61	2	29.0	16.5	30.0	23.3	2.45	68.2	68.2	5Df	5.8	0.9	5.2	25	Yes	Yes	
7	11161-66	5	1.4	-3.0	2.4	0.0	2.76	47.5	47.5	3Bb	110	0.9	99	13.5K	Yes		
8	11166-70	4	21.0	8.0	22.0	15.0	2.57	47.5	47.5	3Bb	6	0.9	5.4	38	Yes		1,847
9	11170-72	2	14.2	2.7	15.2	9.0	2.66	55.0	55.0	4Cd	11	0.9	9.9	47	Yes		474
10	11172-74	2	21.0	9.4	22.0	15.7	2.56	57.2	57.2	4Bc	6.7	0.9	6	34	Yes		1,029
11	11174-78	4	3.1	-1.3	4.1	1.4	2.73	49.9	49.9	3Cc	18	0.9	16.2	238	Yes		
12	11178-80	2	10.0	2.5	11.0	6.8	2.67	52.0	52.0	3Bc	6	0.9	5.4	84	Yes		
13	11180-85	5	1.5	0.0	2.5	1.3	2.71	50.1	50.1	2Cc	50	0.9	45	153	Yes		
14	11185-87	2	1.6	2.1	2.6	2.4	2.675	50.9	50.9	2Cc	65	0.9	58.5	73	Yes		
15	11187-88	1	1.0	1.0	2.0	1.5	2.70	50.0	50.0	2Cc	70	0.9	63	112			
16	11188-94	6	1.0	3.5	2.0	2.8	2.65	51.3	51.3	1Cb	50	0.9	45	71			
17	11194-97	3	0.9	0.1	1.9	1.0	2.71	50.0	50.0	2Cc	360	0.9	324	74			
18	11197-99	2	0.3	1.9	1.8	1.9	2.685	50.4	50.4	2Cc	90	0.9	81	78			
19	11199-11202	3	0.5	0.1	1.5	0.8	2.71	49.9	49.9	2Cc	170	0.9	153	135			
20	11202-05	3	5.0	3.0	6.0	4.5	2.66	52.0	52.0	2Cc	14	0.9	12.6	83			
21	11205-07	2	10.0	6.9	11.0	9.0	2.60	54.0	54.0	2Bb	6	0.9	5.4	64			
22	11207-10	3	5.5	1.0	6.5	3.8	2.69	50.7	50.7	3Cc	10.5	0.9	9.5	114			
23	11210-13	3	14.3	4.0	15.3	9.7	2.645	54.5	54.5	4Bd	3.1	0.9	2.8	82			
24	11213-15	2	1.0	-2.2	2.0	0.0	2.75	49.2	49.2	3Cc	39	0.9	35.1	22.6K			
25	11215-17	2	2.8	0.0	3.8	1.9	2.715	50.1	50.1	2Cc	20	0.9	18	166			
26	11217-19	2	2.4	-1.4	3.4	1.0	2.73	49.7	49.7	2Cc	160	0.9	144	111			
27	11219-21	2	4.1	3.5	5.1	5.3	2.65	56.2	56.2	2De	40	0.9	36	52			
28	11221-23	2	1.5	-0.4	2.5	1.1	2.72	50.7	50.7	2Cc	70	0.9	63	153			
29	11223-26	3	2.2	1.0	3.2	2.1	2.69	54.6	54.6	2De	70	0.9	63	80			
30	11226-29	3	1.0	-0.6	2.0	0.7	2.715	50.1	50.1	2Cc	110	0.9	99	192			
31	11229-32	3	1.8	-0.1	2.8	1.4	2.71	51.8	51.8	2Dd	29	0.9	26.1	187			
32	11232-35	3	1.1	-3.5	2.1	0.0	2.765	49.7	49.7	3Cd	39	0.9	35.1	22.6K			
33	11235-40	5	2.0	-1.9	3.0	0.6	2.74	49.9	49.9	2Cc	27	0.9	24.3	453			
34	11240-42	2	1.2	-0.9	2.2	0.7	2.725	51.8	51.8	2Dd	80	0.9	72	225			
35	11242-45	3	1.5	-2.3	2.5	0.1	2.75	48.6	48.6	3Cc	250	0.9	225	894			
36	11245-49	4	5.3	3.0	6.3	4.7	2.66	55.0	55.0	2Dd	30	0.9	27	54			
37	11249-53	4	2.0	-2.0	3.0	0.5	2.745	51.0	51.0	3Dd	80	0.9	72	316			
38	11253-57	4	18.8	7.2	19.8	13.5	2.60	58.3	58.3	4Cc	2.8	0.9	2.5	62			

Table E-34: Combined results of rock-typing and quantitative formation evaluation, Guenther #2-8 swne 8-33N-58E.

Zone#	Depth	H	ϕ_{NW}	ϕ_D	ϕ_{MC}	Xplot ϕ	Pb	Δt	Δt_c	Code	Rt	CF	Rtc	Swt	DST	Perf.	By-passed OIP (MBO)
1	11162-70	8	-1.0	-10+	0.0	0.0	2.975	50.0	50.0	6Df	40K	1.0	40K	670	Yes		
2	11170-76	6	8.0	-3.8	7.0	1.6	2.77	46.8	46.8	3Ab	90	1.0	90	88	Yes		
3	11176-81	5	0.6	-9.0	1.6	0.0	2.855	43.3	43.3	5Ab	1.1K	1.0	1.1K	4.0K	Yes		417
4	11181-84	3	3.6	3.3	4.6	4.0	2.76	46.6	46.6	4Ab	120	1.0	120	30	Yes		
5	11184-85	1	2.0	-5.9	3.0	0.0	2.80	45.5	45.5	4Ab	500	1.0	500	6.0K	Yes		
6	11185-87	2	2.5	-5.8	3.5	0.0	2.80	45.4	45.4	4Ab	410	1.0	410	6.6K	Yes		
7	11187-89	2	6.5	-6.1	3.0	0.0	2.81	44.4	44.4	4Ab	1.0K	1.0	1.0K	4.2K	Yes		
8	11189-92	3	3.0	-6.0	4.0	0.0	2.81	46.0	46.0	4Ac	800	1.0	800	4.7K	Yes		
9	11192-93	1	2.0	-6.3	3.0	0.0	2.775	45.6	45.6	4Ac	1.5K	1.0	1.0K	3.5K	Yes		
10	11193-97	4	6.7	-2.5	7.7	2.6	2.75	47.0	47.0	3Ab	200	1.0	200	36	Yes		
11	11197-11202	5	6.0	-4.9	7.0	1.1	2.80	45.9	45.9	4Ab	800	1.0	800	43	Yes		372
12	11202-05	3	12.0	1.2	13.0	7.1	2.69	50.7	50.7	4Ac	22	1.0	22	40	Yes		156
13	11205-06	1	21.0	11.6	22.0	16.8	2.525	58.0	58.0	4Bc	7	1.0	7	30	Yes		635
14	11206-10	4	17.2	6.8	18.2	12.5	2.60	56.0	56.0	4Bc	9	1.0	9	35	Yes		876
15	11210-14	4	36.0	23.5	37.0	30.3	2.63	62.9	62.9	5Aa	4	1.0	4	22	Yes		1,412
16	11214-18	4	6.0	5.8	7.0	6.4	2.62	53.0	53.0	2Cb	20	1.0	20	46	Yes		4,694
17	11218-20	2	6.8	6.0	7.8	6.9	2.62	53.3	53.3	2Cb	20	1.0	20	43	Yes		391
18	11220-22	2	5.3	3.3	6.3	4.8	2.65	52.0	52.0	2Cb	40	1.0	40	44	Yes		267
19	11222-25	3	25.0	15.0	26.0	20.5	2.47	69.5	69.5	4Df	3	1.0	3	37	Yes		1,924
20	11225-30	5	20.0	5.7	21.0	13.4	2.62	58.0	58.0	5Cc	5.5	1.0	5.5	42	Yes		1,929
21	11230-32	2	26.0	14.0	27.0	20.5	2.485	62.0	62.0	4Bd	4.8	1.0	4.8	29	Yes		1,445
22	11232-35	3	23.2	10.4	24.2	17.3	2.54	61.1	61.1	4Cc	6	1.0	6	31	Yes		1,778
23	11235-39	4	24.0	11.9	25.0	18.5	2.52	60.9	60.9	4Bd	5.9	1.0	5.9	29	Yes		2,609
24	11239-42	3	10.1	2.8	11.1	7.0	2.67	53.5	53.5	3Cd	25	1.0	25	38	Yes		754
25	11242-44	2	15.3	4.6	16.3	10.5	2.64	54.5	54.5	4Bc	10.4	1.0	10.4	39	Yes		477
26	11244-45	1	11.9	3.5	12.9	8.2	2.65	54.0	54.0	3Cc	20	1.0	20	36	Yes		261
27	11245-46	1	18.0	4.1	19.0	11.6	2.645	54.0	54.0	4Ac	19	1.0	19	26	Yes		639
28	11246-51	5	8.2	0.9	9.2	5.1	2.70	52.0	52.0	3Cc	30	1.0	30	48	Yes		593
29	11251-54	3	24.7	15.0	25.7	20.4	2.47	64.6	64.6	4De	10	1.0	10	20	Yes		
30	11254-56	2	20.3	10.7	21.3	16.0	2.54	59.9	59.9	4Cd	12	1.0	12	24	Yes		
31	11256-58	2	22.9	13.8	23.9	18.9	2.49	61.8	61.8	4Cd	7	1.0	7	26	Yes		
32	11258-59	1	21.1	10.2	22.1	16.2	2.55	59.9	59.9	4Cd	8	1.0	8	29	Yes		
33	11259-62	3	22.0	10.5	23.0	16.8	2.54	60.0	60.0	4Cd	8	1.0	8	28	Yes		
34	11262-64	2	16.9	-1.3	17.9	8.3	2.73	49.0	49.0	5Ac	46	1.0	46	23	Yes		635
35	11264-65	1	10.0	2.0	11.0	6.5	2.685	55.0	55.0	3De	34	1.0	34	35	Yes		315
36	11265-68	3	4.4	-0.7	5.4	2.4	2.725	52.4	52.4	3Dd	100	1.0	100	55	Yes		
37	11268-71	3	14.7	2.7	15.7	9.2	2.67	56.0	56.0	4Cc	19	1.0	19	33	Yes		918
38	11271-73	2	6.1	1.0	7.1	4.1	2.69	52.2	52.2	3Cc	27	1.0	27	62	Yes		
39	11273-78	5	21.6	8.0	22.6	15.3	2.585	57.5	57.5	5Bd	2.2	1.0	2.2	59	Yes		
40	11278-88	10	1.0	-2.6	2.0	0.0	2.745	48.0	48.0	2Bd	260	1.0	260	8.3K	Yes		
41	11288-91	3	4.9	-0.2	5.9	2.9	2.72	49.8	49.8	3Bc	17	1.0	17	112	Yes		
42	11291-93	2	4.2	-2.0	5.2	1.6	2.745	50.0	50.0	3Cc	23	1.0	23	174	Yes		
43	11293-96	3	5.1	-1.0	6.1	2.6	2.725	49.8	49.8	3Cc	17	1.0	17	125	Yes		
44	11296-98	2	3.0	-2.5	4.0	0.8	2.75	49.0	49.0	3Cc	25	1.0	25	335	Yes		
45	11298-11302	4	8.3	1.5	9.3	5.4	2.69	51.1	51.1	3Bc	9	1.0	9	82	Yes		
46	11302-08	6	1.8	-3.2	2.8	0.0	2.755	47.8	47.8	3Bb	120	1.0	120	12.7	Yes		
47	11308-11	3	8.0	0.1	9.0	4.6	2.705	51.1	51.1	3Cc	10	1.0	10	97	Yes		
48	11311-12	1	5.1	-1.2	6.1	2.5	2.73	50.0	50.0	3Cc	14	1.0	14	143	Yes		
49	11312-15	3	7.0	2.2	8.0	5.1	2.68	51.2	51.2	3Bc	9	1.0	9	87	Yes		
50	11315-19	4	2.0	-1.0	3.0	1.0	2.725	49.0	49.0	2Cb	30	1.0	30	244	Yes		
51	11319-26	7	1.0	-2.0	2.0	0.0	2.75	48.1	48.1	3Cc	100	1.0	100	13.4K	Yes		
52	11326-29	3	0.6	-0.8	1.6	0.4	2.72	48.0	48.0	2Bb	24	1.0	24	684	Yes		
53	11329-35	6	0.3	-1.7	1.3	0.0	2.74	48.0	48.0	2Cb	30	1.0	30	24.5K	Yes		
54	11335-37	2	0.1	-3.3	1.1	0.0	2.76	47.9	47.9	3Bc	50	1.0	50	19.0K	Yes		

Table E-35: Combined results of rock-typing and quantitative formation evaluation, PPC-Aminoil #1 Guenther Anderson, nese 17-23N-58E.

Zone#	Depth	H	PH	SD	SWC	Xplot	Ø	Pb	Δt	Δtc	Code	Rt	CF	Rtc	Swf	DST	Perf.	By-passed OIP(MBO)
1	11126-34	8	-0.4	-10+	0.0	0.0	2.99	50.6	50.0	6Df	50K	1.0	1.0	50K	599			
2	11134-37	3	8.0	-1.4	8.4	3.5	2.73	48.5	47.9	3Ab	50	1.0	1.0	50	54	Yes		
3	11137-38	1	7.1	-6.0	7.5	0.8	2.81	46.7	46.1	4Ac	50	1.0	1.0	50	237	Yes		
4	11138-46	8	26.0	12.0	26.4	19.2	2.52	61.9	61.3	5Bc	5.0	1.0	1.0	5.0	31	Yes	Yes	
5	11146-50	4	25.0	8.8	25.4	17.1	2.56	60.8	60.2	5Cc	10.7	1.0	1.0	10.7	23	Yes	Yes	
6	11150-56	6	28.0	13.8	28.4	21.1	2.50	65.6	65.0	5Df	26	1.0	1.0	26	12	Yes	Yes	
7	11156-62	6	16.4	4.5	16.8	10.7	2.635	56.0	55.4	4Dd	23	1.0	1.0	23	26	Yes	Yes	
8	11162-64	2	24.6	11.7	25.0	18.4	2.53	66.9	66.3	5Df	6	1.0	1.0	6	29	Yes	Yes	
9	11164-66	2	22.4	9.0	22.8	15.9	2.555	61.7	61.1	4De	10.4	1.0	1.0	10.4	26	Yes	Yes	
10	11166-68	2	30.1	16.6	30.5	23.6	2.45	69.0	68.4	5Df	10	1.0	1.0	10	17			
11	11168-72	4	2.0	-1.3	2.4	0.6	2.725	50.0	49.4	2Cc	100	1.0	1.0	100	223			
12	11172-74	2	4.2	2.6	4.6	3.6	2.67	53.7	53.1	2Dc	25	1.0	1.0	25	74			
13	11174-75	1	4.2	-0.7	4.6	2.0	2.715	53.7	53.1	3Cc	10.8	1.0	1.0	10.8	74	Yes		
14	11175-77	2	8.0	2.6	8.4	5.5	2.665	53.7	53.1	3Cc	22	1.0	1.0	22	143	Yes		
15	11177-80	3	5.5	-2.0	5.9	2.0	2.735	52.0	51.4	3Dd	10.5	1.0	1.0	10.5	125	Yes		
16	11180-85	3	2.1	4.0	2.5	3.3	2.65	53.8	53.2	2Dc	10.6	1.0	1.0	10.6	69	Yes		
17	11185-88	3	5.6	5.8	6.0	5.9	2.62	55.9	55.3	2Dc	4.3	1.0	1.0	4.3	75	Yes		
18	11188-91	2	3.2	1.7	3.6	2.7	2.685	53.0	52.4	2Dc	10.7	1.0	1.0	10.7	91	Yes		
19	11191-92	1	6.0	2.6	6.4	4.5	2.67	53.0	52.4	2Dd	10.7	1.0	1.0	10.7	82	Yes		
20	11192-95	3	5.1	1.2	5.5	3.4	2.685	52.9	52.3	2Cc	23	1.0	1.0	23	81	Yes		
21	11195-11202	7	21.1	10.0	21.5	15.8	2.55	65.2	64.6	4Df	1.8	1.0	1.0	1.8	63	Yes		
22	11202-06	4	20.0	4.2	20.4	12.3	2.645	59.0	58.4	5Cf	1.8	1.0	1.0	1.8	58	Yes		
23	11206-08	2	23.5	10.3	23.9	17.1	2.55	61.3	60.7	4Cc	7	1.0	1.0	7	40			751
24	11208-10	2	20.0	4.8	20.4	12.6	2.625	60.5	59.4	4Df	3.1	1.0	1.0	3.1	50			1,509
25	11210-14	4	22.0	8.0	22.4	15.2	2.50	60.0	63.4	3Df	10.5	1.0	1.0	10.5	78			
26	11214-18	4	9.8	0.3	10.2	5.3	2.70	60.0	55.4	3De	2.3	1.0	1.0	2.3	78			
27	11218-23	5	16.0	6.0	16.4	11.2	2.615	62.3	61.7	4Df	10.2	1.0	1.0	10.2	80			
28	11223-26	3	10.0	0.0	10.4	5.2	2.705	54.8	54.2	3De	10.1	1.0	1.0	10.1	53			
29	11226-28	2	11.7	5.4	12.1	8.8	2.63	56.7	56.1	3Cc	1.7	1.0	1.0	1.7	58			
30	11228-30	2	11.3	2.7	11.7	7.2	2.66	56.7	56.1	3De	31	1.0	1.0	31	76			
31	11230-35	5	20.0	6.8	20.4	13.6	2.60	64.2	63.6	4Df	7	1.0	1.0	7	64			
32	11235-39	4	6.0	-2.0	6.4	3.2	2.73	51.7	51.1	3Cd	20	1.0	1.0	20	88			
33	11239-44	5	13.8	1.5	14.2	7.9	2.69	60.0	49.4	4Df	15	1.0	1.0	15	96			
34	11244-50	6	8.6	-2.2	9.0	3.4	2.74	52.8	52.2	3De	8	1.0	1.0	8	314			
35	11250-55	5	17.2	2.0	17.6	9.8	2.68	60.8	60.4	5Df	5	1.0	1.0	5	84			
36	11255-64	9	3.8	-2.0	4.2	1.1	2.735	51.9	51.3	3Dd	5	1.0	1.0	5	120			
37	11264-66	2	8.0	2.8	8.4	5.6	2.66	54.0	53.4	3Cc	5.4	1.0	1.0	5.4	106			
38	11266-71	5	10.0	-0.5	10.4	5.0	2.71	53.5	52.9	3Cd	2.3	1.0	1.0	2.3	114			
39	11271-74	3	12.1	3.0	12.5	7.8	2.685	56.0	55.4	3Cd	6	1.0	1.0	6	152			
40	11274-76	2	9.2	1.1	9.6	5.4	2.69	54.1	53.5	3Cd	4	1.0	1.0	4	103			
41	11276-78	2	10.6	4.4	11.0	7.7	2.64	56.6	56.0	3Dd	10	1.0	1.0	10	184			
42	11278-81	3	7.5	-0.8	7.9	3.6	2.725	53.8	53.2	3De	4	1.0	1.0	4	104			
43	11281-84	3	9.2	3.3	9.6	6.5	2.65	54.2	53.6	3Cc	4	1.0	1.0	4	139			
44	11284-87	3	6.0	-1.8	6.4	2.3	2.725	52.5	51.9	3Dd	2.5	1.0	1.0	2.5	110			
45	11287-90	3	10.0	4.3	10.4	7.4	2.635	56.0	55.4	3Dd	3	1.0	1.0	3	123			
46	11290-93	3	9.5	-0.4	9.9	4.8	2.71	54.6	54.0	3De	3	1.0	1.0	3	119			
47	11293-95	2	11.0	3.9	11.4	7.7	2.65	56.4	55.8	3Dd	9	1.0	1.0	9	120			
48	11295-97	2	7.2	0.5	7.6	4.1	2.70	53.2	52.6	3Cd	4	1.0	1.0	4	93			
49	11297-11302	5	9.5	3.0	9.9	6.5	2.67	56.0	55.4	3De	8	1.0	1.0	8	237			
50	11302-06	4	8.0	-1.0	8.4	3.7	2.73	52.9	52.3	3Cd	8	1.0	1.0	8				
51	11306-10	4	10.0	4.0	10.4	7.2	2.70	56.0	55.4	4De	8	1.0	1.0	8				
52	11310-17	7	4.7	-1.1	5.1	2.0	2.72	53.2	52.6	3Dd	8	1.0	1.0	8				

Table E-36: Combined results of rock-typing and quantitative formation evaluation, Sampson #1-21, nose 21-33W-58E.

Zone#	Depth	H	ϕ_{H_2O}	ϕ_{MC}	Xplot ϕ	Pb	Δt	Δt_c	Code	Rt	CP	Rtc	Sw _h	DST Perf.	By-passed OIP(MBO)
1	11278-87	9	-1.5	-10+	0.0	0.0	2.95	50.5	50.0	6Df	400	0.6	240	Yes	
2	11287-91	4	8.5	0.5	10.0	5.3	2.70	47.3	46.8	3Aa	50	0.6	30	Yes	568
3	11291-93	2	10.9	2.0	12.4	7.2	2.675	48.6	48.1	3Aa	30	0.6	18	Yes	408
4	11293-96	3	10.2	0.0	11.7	5.9	2.705	47.4	46.9	4Aa	24	0.6	14.4	Yes	
5	11296-99	3	22.9	15.1	24.4	19.8	2.47	63.6	63.1	4Cd	1.1	0.6	0.66	Yes	
6	11299-11301	2	22.0	13.5	23.5	18.5	2.495	63.3	62.8	4Ce	1.4	0.6	0.84	Yes	
7	11301-04	3	24.0	17.5	25.5	21.5	2.425	67.5	67.0	3Df	1.1	0.6	0.66	Yes	1,114
8	11304-09	5	8.8	3.0	10.3	6.7	2.66	49.0	48.5	3Aa	60	0.6	36	Yes	
9	11309-12	3	15.9	8.0	17.4	12.7	2.58	55.8	55.3	3Bc	6.8	0.6	4.1	Yes	
10	11312-16	4	8.8	-0.9	10.3	4.7	2.725	50.5	50.0	4Bc	17	0.6	10.2	Yes	
11	11316-20	4	12.0	5.0	13.5	9.3	2.63	53.0	52.5	3Bb	6.1	0.6	3.7	Yes	
12	11320-25	5	2.2	4.0	3.7	3.9	2.645	50.0	49.5	2Ba	82	0.6	49.2	Yes	494
13	11325-28	3	3.0	0.0	5.0	2.5	2.705	49.7	49.2	2Ba	48	0.6	28.8	Yes	
14	11328-30	2	5.7	2.1	7.2	4.7	2.675	51.3	50.8	3Bb	24	0.6	14.4	Yes	
15	11330-34	4	3.0	0.0	4.5	2.3	2.71	50.0	49.5	2Bb	40	0.6	24	Yes	
16	11334-36	2	3.9	4.0	5.4	4.7	2.645	51.4	50.9	2Bb	21	0.6	12.6	Yes	
17	11336-39	3	4.0	3.2	5.5	4.4	2.655	50.5	50.0	2Ba	70	0.6	42	Yes	347
18	11339-43	4	3.0	4.3	4.5	4.4	2.635	51.1	50.6	2Ba	36	0.6	21.6	Yes	
19	11343-48	5	0.6	2.7	2.1	2.4	2.67	49.1	48.6	2Ba	90	0.6	54	Yes	
20	11348-53	5	17.0	14.4	18.5	16.5	2.48	61.1	60.6	3Cc	1.3	0.6	0.78	Yes	
21	11353-55	2	19.5	7.1	21.0	14.5	2.585	56.6	56.1	2Bc	2.1	0.6	1.3	Yes	
22	11355-57	2	21.9	15.8	23.4	19.6	2.46	65.5	65.0	3De	1.2	0.6	0.72	Yes	
23	11357-59	2	19.7	14.0	21.2	17.6	2.49	62.3	61.8	3Cd	1.6	0.6	0.96	Yes	
24	11359-64	5	20.9	14.2	22.4	18.3	2.485	60.8	60.3	3Bc	1.7	0.6	1.0	Yes	
25	11364-68	4	10.3	3.7	11.8	7.8	2.75	52.8	52.3	5Be	11	0.6	6.6	Yes	
26	11368-71	3	13.2	4.9	14.7	9.8	2.73	55.2	54.7	6Bf	6	0.6	3.6	Yes	459
27	11371-74	3	7.8	1.7	9.3	5.5	2.59	52.9	52.4	3Cc	50	0.6	30	Yes	
28	11374-76	2	9.7	4.7	11.2	8.0	2.64	57.0	56.5	3De	17	0.6	10.2	Yes	
29	11376-81	5	8.0	3.3	9.5	6.4	2.655	52.0	51.5	3Bb	17	0.6	10.2	Yes	
30	11381-86	5	20.1	12.0	21.6	16.0	2.52	60.0	59.5	4Bc	2.3	0.6	1.4	Yes	
31	11386-88	2	11.2	1.2	12.7	7.0	2.69	50.0	49.5	4Ab	51	0.6	30.6	Yes	459
32	11388-90	2	12.2	4.3	13.7	9.0	2.64	52.0	51.5	3Ab	15	0.6	9	Yes	570
33	11390-93	3	8.1	0.1	9.6	4.9	2.70	51.1	50.6	3Bc	170	0.6	102	Yes	444
34	11393-98	5	14.7	7.0	16.2	11.6	2.59	56.0	55.5	3Bc	60	0.6	36	Yes	2,212

Table E-37: Combined results of rock-typing and quantitative formation evaluation, Arnekleiv #1, ms/4 5-34W-56E.

Zone#	Depth	H	ρ_m	ρ_{ac}	Xplot	ϕ	Pb	Δt	Δt_c	Code	Rt	CP	Rtc	Swt	DST	Perf.	By-passed OIP(MBO)
1	10863-73	10	-1.0	-10+	0.0	0.0	2.99	50.1	50.0	6Df	28K	0.83	23K	884			
2	10873-77	4	13.7	-1.0	14.7	6.6	2.73	48.9	48.8	4Ab	13	0.83	10.8	61	Yes		
3	10877-81	4	11.0	-4.0	12.0	4.0	2.775	48.3	48.2	4Ac	14	0.83	11.6	98	Yes		
4	10881-84	3	26.5	10.2	27.5	18.9	2.55	61.6	61.5	4Cc	1.0	0.83	0.8	77	Yes		
5	10884-88	4	23.9	7.1	24.9	16.0	2.60	60.0	59.9	5Cf	1.3	0.83	1.1	79	Yes		
6	10888-93	5	30.6	14.0	31.6	22.8	2.48	64.3	64.2	5Cc	1.3	0.83	1.1	56	Yes		
7	10893-96	3	17.7	2.0	18.7	10.4	2.68	53.4	53.3	5Bd	6	0.83	5.0	57	Yes		
8	10896-98	2	20.1	3.2	21.1	12.2	2.65	53.4	53.3	5Ac	5	0.83	4.2	53			
9	10898-10901	3	18.9	1.0	19.9	10.5	2.70	52.2	52.1	5Ac	7	0.83	5.8	53			
10	10901-05	4	22.0	6.3	23.0	14.7	2.60	56.1	56.0	5Ac	3	0.83	2.5	57			
11	10905-08	3	17.0	2.0	18.0	10.0	2.68	54.0	53.9	5Bd	4.8	0.83	4.0	67			
12	10908-12	4	2.0	-3.1	3.0	0.0	2.755	49.9	49.8	3Cc	21	0.83	17.4	32.2K			
13	10912-16	4	7.3	-1.0	8.3	3.7	2.725	51.7	51.6	3Cd	7	0.83	5.8	150			
14	10916-21	5	1.3	1.4	2.3	1.9	2.69	51.2	51.1	2Cc	23	0.83	19.1	161			
15	10921-24	3	0.5	0.1	1.5	0.8	2.705	50.2	50.1	2Cc	60	0.83	49.8	237			
16	10924-26	2	2.1	2.1	3.1	2.6	2.67	52.0	51.9	2Cc	16	0.83	13.2	142			
17	10926-28	2	1.7	1.6	2.7	2.2	2.69	51.7	51.6	2Cc	24	0.83	19.9	136			
18	10928-30	2	4.6	3.9	5.6	4.8	2.65	53.8	53.7	2Cc	8	0.83	6.6	108			
19	10930-34	4	4.3	0.8	5.3	3.1	2.70	52.7	52.6	3Dd	9	0.83	7.5	158			
20	10934-36	2	15.4	3.5	16.4	10.0	2.65	53.7	53.6	4Df	2	0.83	1.7	102			
21	10936-38	2	6.1	-2.3	7.1	2.4	2.75	53.0	52.9	3Cd	6	0.83	5.0	249			
22	10938-40	2	8.5	0.8	9.5	5.2	2.70	53.0	52.9	3Cd	6	0.83	5.0	115			
23	10940-43	3	7.5	-1.0	8.5	3.8	2.73	53.2	52.1	3Cd	6	0.83	5.0	157			
24	10943-45	2	8.0	-1.1	9.0	5.1	2.695	54.0	53.9	3Cd	6	0.83	5.0	117			
25	10945-47	2	4.0	-1.5	5.0	1.8	2.74	53.8	50.7	3Cd	40	0.83	33.2	129			
26	10947-49	2	26.1	1.9	27.1	14.5	2.685	56.0	55.9	6Ac	16	0.83	13.3	25			889
27	10949-51	2	2.7	-1.4	3.7	1.2	2.73	52.5	52.4	2Dd	40	0.83	33.2	194			
28	10951-53	2	4.0	-1.0	5.0	2.0	2.725	52.5	52.4	3Dd	10.9	0.83	9.1	222			
29	10953-55	2	2.0	-2.0	3.0	0.5	2.74	51.1	51.0	2Dd	20.8	0.83	17.3	645			
30	10955-59	4	9.1	2.5	10.1	6.3	2.67	56.1	56.0	3Dd	3.1	0.83	2.6	132			
31	10959-62	3	7.0	1.0	8.0	4.5	2.695	54.0	53.9	3Dd	6	0.83	5.0	133			
32	10962-68	6	2.0	-2.1	3.0	0.5	2.75	49.8	49.7	3Cc	100	0.83	83	294			
33	10968-72	4	3.0	-0.4	4.0	1.8	2.72	52.2	52.1	2Dd	50	0.83	41.5	115			
34	10972-77	5	19.8	5.0	20.8	12.9	2.63	60.1	60.0	5Df	1.2	0.83	1.0	104			
35	10977-79	2	8.0	0.0	9.0	4.5	2.72	53.8	53.7	3Dd	3.8	0.83	3.2	166			
36	10979-81	2	14.0	2.2	15.0	8.6	2.67	55.0	54.9	4Cd	2.6	0.83	2.2	105			
37	10981-84	3	1.4	0.0	2.4	1.2	2.705	49.6	49.5	2Cb	43	0.83	35.7	187			
38	10984-88	4	0.8	-2.0	1.8	0.0	2.75	49.9	49.8	3Cc	95	0.83	79.9	15.0K			
39	10988-92	4	2.1	-0.5	3.1	1.3	2.72	50.5	50.4	2Cc	19	0.83	15.8	259			
40	10992-94	2	3.4	-0.5	4.4	2.0	2.72	51.3	51.2	3Cc	12	0.83	10.0	212			
41	10994-97	3	4.8	-0.2	5.8	2.8	2.715	51.2	51.1	3Cc	9	0.83	7.5	174			
42	10997-99	2	2.4	-2.1	3.4	0.7	2.75	50.9	50.8	3Cd	13	0.83	10.8	583			
43	10999-11001	2	5.6	-1.5	6.6	2.6	2.73	51.8	51.7	3Cd	6	0.83	5.0	230			
44	11001-05	4	2.4	-1.5	3.4	1.0	2.73	50.0	49.9	2Cc	14	0.83	11.6	393			
45	11005-09	4	2.0	-4.0	3.0	0.0	2.77	51.0	50.9	3Dd	15	0.83	12.5	37.9K			
46	11009-14	5	8.0	0.5	9.0	4.8	2.70	52.8	52.7	3Cd	63	0.83	52.3	38			
47	11014-17	3	3.9	-2.0	4.9	1.5	2.74	50.9	50.8	3Cd	12	0.83	10.0	282			
48	11017-19	2	7.0	-0.4	8.0	3.8	2.72	51.0	50.9	3Cc	7.4	0.83	6.1	142			
49	11019-20	1	3.6	-3.3	4.6	0.7	2.76	50.6	50.5	3Dd	12	0.83	10.0	606			
50	11020-23	3	6.4	0.2	7.4	3.8	2.70	52.0	51.9	3Cd	8	0.83	6.6	137			
51	11023-26	3	2.0	-2.0	3.0	0.5	2.75	51.7	51.6	3Dd	13	0.83	10.8	816			
52	11026-30	4	3.1	1.5	4.1	2.8	2.685	52.0	51.9	2Cc	9.5	0.83	7.9	170			
53	11030-32	2	2.0	-2.0	3.0	0.5	2.74	51.1	51.0	2Dd	17	0.83	14.1	418			
54	11032-34	2	2.9	0.3	3.9	2.1	2.70	50.9	50.8	2Cc	13	0.83	10.8	194			

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Table E-38: Combined results of rock-typing and quantitative formation evaluation, Josie Larsh #14-1, sene 14-34N-56E.

Zone#	Depth	H	ρ _m	ρ _D	ρ _{ac}	Xplot	ρ	Pb	Δt	Δtc	Code	Rt	CP	Rtc	Sat	DST	Perf.	By-passed OIP(MBO)
1	11032-40	8	-1.0	-10+	0.0	0.0	2.98	50.9	50.0	50.0	6Df	50K	0.63	31.5K	755	Yes		
2	11040-43	3	9.8	-2.7	10.8	4.1	2.75	49.9	49.1	49.1	4Bc	22	0.63	13.9	87	Yes		
3	11043-48	5	7.9	-6.0	8.9	1.5	2.81	46.0	45.1	45.1	4Bb	40.5	0.63	25.5	177	Yes		
4	11048-55	7	31.0	16.9	32.0	24.5	2.44	69.0	68.1	68.1	5Df	1.6	0.63	1.0	54	Yes	Yes	
5	11055-62	7	4.0	0.0	5.0	2.5	2.71	50.4	49.5	49.5	3Bb	13	0.63	8.2	187	Yes	Yes	
6	11062-66	4	24.2	10.5	25.2	17.9	2.54	60.8	59.9	59.9	5Bd	7	0.63	4.4	35	Yes	Yes	
7	11066-69	3	7.2	-3.5	8.2	2.4	2.76	53.1	52.2	52.2	3De	10	0.63	6.3	222	Yes	Yes	
8	11069-71	2	14.2	1.5	15.2	8.4	2.685	57.1	56.2	56.2	4De	8	0.63	5.0	71	Yes	Yes	
9	11071-73	2	10.5	-1.1	11.5	5.2	2.73	53.2	51.3	51.3	4Bd	16	0.63	10.1	81	Yes	Yes	
10	11073-75	2	12.9	3.9	13.9	8.9	2.65	54.7	53.8	53.8	4Bc	8	0.63	5.0	67	Yes	Yes	
11	11075-77	2	2.0	0.0	3.0	1.5	2.70	51.4	50.5	50.5	2Cc	11	0.63	6.9	340	Yes		
12	11077-80	3	7.5	2.0	8.5	5.3	2.68	52.9	52.0	52.0	3Cc	10	0.63	6.3	100	Yes		
13	11080-84	4	1.0	-1.4	2.0	6.3	2.73	51.0	50.1	50.1	2Cc	30	0.63	18.9	1.0K	Yes		
14	11084-87	3	1.3	1.4	2.3	1.9	2.655	52.8	51.9	51.9	1Db	25	0.63	15.8	177			
15	11087-91	4	0.0	-2.0	1.0	0.0	2.745	50.0	49.1	49.1	2Cc	320	0.63	201.6	9.4K			
16	11091-94	3	0.2	0.4	1.2	2.5	2.71	50.3	49.4	49.4	2Cb	90	0.63	56.7	222			
17	11094-1100	6	1.5	1.7	2.5	2.1	2.69	52.0	51.1	51.1	2Cc	22	0.63	13.9	171			
18	11100-03	3	3.5	0.1	4.5	2.3	2.705	52.7	51.8	51.8	2Dc	8	0.63	5.0	260			
19	11103-08	5	0.7	-2.0	1.7	0.0	2.75	49.7	48.8	48.8	4Cc	60	0.63	37.8	21.8K			
20	11108-14	6	4.3	2.0	5.3	3.7	2.675	56.9	56.0	56.0	2De	22	0.63	13.9	97			
21	11114-16	2	2.0	-1.5	3.0	0.8	2.73	50.7	49.8	49.8	2Cc	50	0.63	31.5	298			
22	11116-18	2	1.4	1.0	2.4	1.7	2.70	51.2	50.3	50.3	2Cc	50	0.63	31.5	140			
23	11118-20	2	1.0	-1.5	2.0	0.3	2.73	51.0	50.1	50.1	2Cc	103	0.63	64.9	555			
24	11120-21	1	2.1	-0.5	3.1	1.3	2.72	52.8	51.9	51.9	2Dd	30	0.63	18.9	237			
25	11121-24	3	1.1	-2.9	2.1	0.0	2.755	50.8	49.9	49.9	3Cc	60	0.63	37.8	21.8K			
26	11124-26	2	2.5	-0.3	3.5	1.6	2.715	52.0	51.1	51.1	2Dc	18	0.63	11.3	249			
27	11126-28	2	2.5	-4.1	3.5	0.0	2.775	50.8	49.9	49.9	3Cd	18	0.63	11.3	39.9K			
28	11128-30	2	6.1	0.9	7.1	4.0	2.70	52.7	51.8	51.8	3Cc	12	0.63	7.6	121			
29	11130-34	4	1.8	-2.0	2.8	0.4	2.75	49.8	48.9	48.9	3Cc	102	0.63	64.3	418			
30	11134-37	3	2.2	1.0	3.2	2.1	2.695	54.0	53.1	53.1	2Dd	100	0.63	63.0	338			
31	11137-42	5	1.9	-2.0	2.9	0.5	2.75	50.5	49.6	49.6	3Cc	100	0.63	63.0	338			
32	11142-48	6	16.0	3.7	17.0	10.4	2.65	58.0	57.1	57.1	4Cc	2.1	0.63	1.3	113			
33	11148-55	7	0.5	-3.0	1.5	0.0	2.75	49.6	48.7	48.7	3Cc	60	0.63	37.8	21.8K			
34	11155-57	2	1.0	0.0	2.0	1.0	2.70	50.0	49.1	49.1	2Cb	68	0.63	42.8	205			
35	11157-59	2	0.8	-2.7	1.8	0.0	2.75	49.8	48.9	48.9	3Cc	68	0.63	42.8	20.5K			
36	11159-61	2	0.8	0.0	1.8	0.9	2.71	49.7	48.8	48.8	2Cb	40	0.63	25.2	296			
37	11161-63	2	0.8	-2.1	1.8	0.0	2.75	49.9	49.0	49.0	3Cc	45	0.63	28.4	25.2K			
38	11163-66	3	1.0	-1.0	2.0	0.5	2.725	49.9	49.0	49.0	2Cb	33	0.63	20.8	588			
39	11166-70	4	0.9	-3.7	1.9	0.0	2.765	50.2	49.3	49.3	3Cc	30	0.63	18.9	30.9K			
40	11170-72	2	1.0	-1.5	2.0	0.3	2.73	50.0	49.1	49.1	2Cc	35	0.63	22.1	951			
41	11172-75	3	0.7	-2.6	1.7	0.0	2.75	49.7	48.8	48.8	3Cc	53	0.63	33.4	23.2K			
42	11175-78	3	0.7	0.0	1.7	0.9	2.71	50.0	49.1	49.1	2Cb	40	0.63	25.2	296			
43	11178-86	8	1.8	-3.5	2.8	0.0	2.76	50.4	49.5	49.5	3Cc	33	0.63	20.8	29.4K			
44	11186-89	3	1.7	1.0	2.7	1.9	2.70	50.3	49.4	49.4	2Cb	30	0.63	18.9	162			
45	11189-91	2	0.9	-2.4	1.9	0.0	2.75	50.1	49.2	49.2	3Cc	60	0.63	37.8	21.8K			
46	11191-93	2	0.9	2.0	1.9	2.0	2.68	50.0	49.1	49.1	2Cb	40	0.63	25.2	133			
47	11193-94	1	0.5	-2.0	1.5	0.0	2.74	50.2	49.3	49.3	2Cc	70	0.63	44.1	20.2K			
48	11194-96	2	0.4	0.5	1.4	1.0	2.70	50.4	49.5	49.5	3Cc	80	0.63	50.4	188			
49	11196-97	1	0.9	-4.1	1.9	0.0	2.78	50.0	49.1	49.1	3Cd	90	0.63	56.7	17.8K			
50	11197-99	2	0.7	-1.0	1.7	0.4	2.73	50.0	49.1	49.1	2Cc	80	0.63	50.4	472			
51	11199-11201	2	0.4	-4.0	1.4	0.0	2.775	49.4	48.5	48.5	3Cc	100	0.63	63.0	16.9K			
52	11201-06	5	0.9	1.0	1.9	1.5	2.70	50.0	49.1	49.1	2Cb	70	0.63	44.1	134			
53	11206-15	9	0.1	-3.5	1.1	0.0	2.75	50.0	49.1	49.1	3Cc	100	0.63	63.0	16.9K			

Table E-39: Combined results of rock-typing and quantitative formation evaluation, Johansen et al., memo 25-34W-56E.

Zone#	Depth	H	ρ_m	ρ_D	ρ_{ac}	Xplot ϕ	Pb	Δt	Δt_c	Code	Rt	CF	Rtc	Sat	DST	Perf.	By-passed OIP(MBO)
1	11228-38	10	-0.7	-10+	0.0	0.0	2.98	51.0	50.0	60f	45K	0.80	36K	707			
2	11238-44	6	9.7	-4.5	10.4	3.0	2.78	48.9	47.9	43c	18	0.80	14.4	117			
3	11244-51	7	1.5	-10	2.2	0.0	2.89	45.2	44.2	53c	360	0.80	288.0	7.9K	Yes		
4	11251-53	2	5.7	-6.0	6.4	0.2	2.81	46.8	45.8	43c	90	0.80	72.0	790	Yes		
5	11253-56	3	1.5	-10	2.2	0.0	2.88	43.8	42.8	53c	480	0.80	384.0	6.8K	Yes		
6	11256-58	2	6.0	-4.5	6.7	1.1	2.78	47.2	46.2	3Ab	62	0.80	49.6	173	Yes		
7	11258-63	5	5.3	-8.0	6.0	0.0	2.84	47.1	46.1	48c	180	0.80	144.0	11.2K	Yes		471
8	11263-65	2	12.0	-2.8	12.7	7.8	2.73	49.6	48.6	53b	24	0.80	19.2	39	Yes		
9	11265-70	5	6.0	-1.4	6.7	2.7	2.795	47.8	46.8	43c	90	0.80	72.0	58	Yes		
10	11270-76	6	17.6	2.0	18.3	10.2	2.69	57.0	56.0	40c	5.7	0.80	4.6	61	Yes	Yes	
11	11276-78	2	1.2	-0.7	1.9	0.6	2.73	51.5	50.5	20c	40	0.80	32.0	395	Yes		
12	11278-82	4	2.4	2.4	3.1	2.8	2.67	52.8	51.8	20c	30	0.80	24.0	97	Yes		
13	11282-85	3	1.0	0.2	1.7	1.0	2.70	49.9	48.9	20b	105	0.80	84.0	146	Yes		
14	11285-86	1	3.8	3.8	4.5	4.2	2.65	52.4	51.4	20b	48	0.80	38.4	51	Yes		
15	11286-88	2	1.7	-2.0	2.4	0.2	2.745	51.8	50.8	20d	58	0.80	46.4	984	Yes		
16	11288-92	4	7.0	1.0	7.7	4.4	2.70	55.0	54.0	30d	17	0.80	13.6	82	Yes	Yes	
17	11292-93	1	10.7	2.6	11.4	7.0	2.66	56.1	55.1	30d	6.8	0.80	5.4	82	Yes	Yes	
18	11293-96	3	9.0	-0.2	9.7	4.8	2.72	53.5	52.5	40d	9.2	0.80	7.4	102	Yes	Yes	
19	11296-99	3	20.4	8.0	21.1	14.6	2.585	65.6	64.6	40f	2.0	0.80	1.6	72	Yes	Yes	
20	11299-304	5	1.0	-4.5	1.7	0.0	2.78	50.0	49.0	30d	40	0.80	32.0	23.7K			
21	11304-08	4	1.0	-0.3	1.7	0.7	2.715	53.1	52.1	20d	90	0.80	72.0	225			
22	11308-11	3	2.0	-2.5	2.7	0.1	2.75	50.5	49.5	30c	85	0.80	68.0	1.6K			
23	11311-14	3	3.1	-0.8	3.8	1.5	2.72	52.0	51.0	20c	40	0.80	32.0	158			
24	11314-16	2	2.0	-2.0	2.7	0.4	2.74	51.0	50.0	20c	90	0.80	72.0	395			
25	11316-18	2	2.5	0.0	3.2	1.6	2.71	51.6	50.6	20c	30	0.80	24.0	171			
26	11318-24	6	1.0	-3.2	1.7	0.0	2.76	50.3	49.3	30d	80	0.80	32.0	23.7K			
27	11324-29	5	1.5	0.0	2.2	1.1	2.71	51.8	50.8	20c	80	0.80	64.0	152			
28	11329-31	2	1.1	-2.7	1.8	0.0	2.75	49.6	48.6	30c	380	0.80	304.0	7.7K			
29	11331-34	3	3.0	0.5	3.7	2.1	2.70	55.1	54.1	20e	86	0.80	68.8	77			
30	11334-37	3	2.0	-3.0	2.7	0.0	2.755	49.8	48.8	30c	250	0.80	200.0	9.5K			
31	11337-39	2	5.8	-0.5	6.5	3.0	2.72	52.0	51.0	30c	7.5	0.80	6.0	182			
32	11339-41	2	5.1	-2.9	5.8	1.5	2.75	52.7	51.7	30d	8.2	0.80	6.6	348			
33	11341-45	4	7.0	1.0	7.7	4.4	2.695	53.5	52.5	30d	6	0.80	4.8	139			
34	11345-50	5	1.0	-4.0	1.7	0.0	2.77	50.0	49.0	30c	700	0.80	560.0	5.7K			
35	11350-53	3	2.9	-0.9	3.6	1.4	2.72	51.5	50.5	20c	24	0.80	19.2	218			
36	11353-55	2	3.3	-2.5	4.0	0.8	2.75	52.0	51.0	30d	16	0.80	12.8	468			
37	11355-57	2	4.8	0.7	5.5	3.1	2.70	52.6	51.6	30c	9	0.80	7.2	161			
38	11357-62	5	3.6	-2.1	4.3	1.1	2.75	52.1	51.1	30d	10.1	0.80	8.1	428			
39	11362-64	2	7.4	2.0	8.1	5.1	2.68	53.6	52.6	30c	6	0.80	4.8	120			
40	11364-69	5	4.0	-1.8	4.7	1.5	2.74	51.0	50.0	30c	13	0.80	10.4	277			
41	11369-70	1	4.3	1.1	5.0	3.1	2.69	52.5	51.5	20c	12	0.80	9.6	139			
42	11370-74	4	4.0	-3.0	4.7	0.9	2.75	52.0	51.0	30d	15	0.80	12.0	430			
43	11374-78	4	9.9	0.9	10.6	5.8	2.70	55.6	54.6	30e	5	0.80	4.0	115			

Table E-40: Combined results of rock-typing and quantitative formation evaluation, Nettle Olson #1-28-1B, new 28-34N-56E.

Zone#	Depth	H	ØN	ØD	ØNC	Xplot	Ø	Pb	Δt	Δtc	Code	Rt	CP	Rtc	Swf	DST	Perf.	By-passed OIP(MBO)
1	10939-48	9	-1.1	-10+	0.0	0.0	0.0	2.95	50.3	50.0	6Df	40K	1.0	40K	670	Yes		
2	10948-53	5	12.0	0.0	13.1	6.5	2.71	49.7	49.4	4Ab	11	11	1.0	11	62	Yes		
3	10953-56	3	6.2	-5.2	7.3	1.1	2.80	46.4	46.1	4Ac	28	28	1.0	28	230	Yes		
4	10956-59	3	22.0	9.1	23.1	16.1	2.555	66.0	65.7	4Df	0.9	0.9	1.0	0.9	60	Yes		
5	10959-61	2	1.0	-5.1	2.1	0.0	2.795	48.7	48.4	3Cd	21	21	1.0	21	29.3K	Yes		
6	10961-66	5	2.1	-2.4	3.2	0.4	2.75	51.0	50.7	3Dd	14	14	1.0	14	896	Yes		
7	10966-68	2	0.3	-3.1	1.4	0.0	2.755	47.4	47.1	3Bb	190	190	1.0	190	9.7	Yes		
8	10968-75	7	21.0	5.5	22.1	13.8	2.62	56.0	45.7	5Bd	2.1	2.1	1.0	2.1	67	Yes		
9	10975-78	3	6.1	-1.8	7.2	2.7	2.74	52.1	51.8	3Cd	8.0	8.0	1.0	8.0	175			
10	10978-82	4	1.8	-3.9	2.9	0.0	2.765	49.0	48.7	3Cc	65	65	1.0	65	16.6K			
11	10982-86	4	0.1	0.5	1.2	0.9	2.70	48.0	47.7	2Ba	600	600	1.0	600	60			
12	10986-88	2	0.9	-3.0	2.0	0.0	2.75	49.0	48.7	3Cc	90	90	1.0	90	14.1K			
13	10988-93	5	0.5	4.0	1.6	2.8	2.645	51.7	51.4	1Cb	40	40	1.0	40	75			
14	10993-97	4	0.1	-0.5	1.2	0.4	2.72	50.9	50.6	2Dc	70	70	1.0	70	400			
15	10997-11000	3	0.7	2.3	1.8	2.1	2.67	51.3	51.0	2Cb	60	60	1.0	60	82			
16	11000-03	3	0.8	0.0	1.9	1.0	2.71	50.2	49.9	2Cc	80	80	1.0	80	150			
17	11003-05	2	2.0	2.0	3.1	2.6	2.67	52.1	51.8	2Dc	14	14	1.0	14	137			
18	11005-06	1	1.2	-0.1	2.3	1.1	2.71	50.9	50.6	2Cc	30	30	1.0	30	222			
19	11006-09	3	2.0	1.7	3.1	2.4	2.68	50.9	50.6	2Cb	20	20	1.0	20	124			
20	11009-17	8	0.0	-3.8	1.1	0.0	2.775	48.0	47.7	3Bc	210	210	1.0	210	9.3K			
21	11017-21	4	0.3	2.0	1.4	1.7	2.68	50.0	49.7	2Cb	80	80	1.0	80	88	Yes		
22	11021-23	2	0.0	-2.0	1.1	0.0	2.745	48.9	48.6	2Cc	205	205	1.0	205	9.4K	Yes		
23	11023-25	2	0.3	0.3	1.4	0.9	2.70	51.5	51.2	2Dc	100	100	1.0	100	149	Yes		
24	11025-27	2	0.0	-5.2	1.1	0.0	2.80	48.5	49.2	4Cd	400	400	1.0	400	6.7K	Yes		
25	11027-29	2	0.0	1.8	1.1	1.5	2.685	50.0	49.7	2Cb	200	200	1.0	200	63	Yes		
26	11029-31	2	0.0	-1.0	1.1	0.1	2.725	49.0	48.7	2Cb	500	500	1.0	500	599	Yes		
27	11031-33	2	0.1	0.8	1.2	1.0	2.70	48.1	47.8	2Ba	190	190	1.0	190	97	Yes		
28	11033-36	3	0.0	-1.8	1.1	0.0	2.74	48.1	47.8	2Bb	590	590	1.0	590	5.5K	Yes		
29	11036-38	2	0.0	0.0	1.1	0.6	2.71	50.6	50.3	2Cc	370	370	1.0	370	116	Yes		
30	11038-43	5	0.0	-3.1	1.1	1.6	2.75	48.7	48.4	3Cc	150	150	1.0	150	4.4K	Yes		
31	11043-45	2	0.8	0.9	1.9	1.4	2.695	51.3	51.0	2Dc	280	280	1.0	280	57	Yes		
32	11045-48	3	0.0	0.0	1.1	0.6	2.715	52.1	51.8	2Dd	950	950	1.0	950	72	Yes		
33	11048-50	2	0.0	2.0	1.1	1.6	2.69	48.0	47.7	2Ba	130	130	1.0	130	73	Yes		
34	11050-56	6	0.1	-3.7	1.2	0.0	2.765	48.1	47.8	3Bc	150	150	1.0	150	11.0K	Yes		
35	11056-60	4	0.1	0.0	1.2	0.6	2.70	48.4	48.1	2Bb	90	90	1.0	90	235			
36	11060-62	2	0.0	-3.0	1.1	0.0	2.755	49.0	48.7	3Cc	180	180	1.0	180	10.0K			
37	11062-64	2	0.0	0.0	1.1	0.6	2.71	48.7	48.4	2Cb	98	98	1.0	98	225			
38	11064-66	2	0.1	-1.4	1.2	0.0	2.73	49.0	48.7	2Cb	110	110	1.0	110	12.8K			
39	11066-68	2	0.1	0.3	1.2	0.8	2.70	49.0	48.7	3Cc	85	85	1.0	85	181			
40	11068-74	6	0.1	-4.0	1.2	0.0	2.775	49.0	48.7	3Cc	105	105	1.0	105	13.1K			
41	11074-77	3	0.3	0.4	1.4	0.9	2.70	49.7	49.4	2Cb	50	50	1.0	50	210			
42	11077-81	4	0.1	-2.0	1.2	0.0	2.745	49.1	48.8	2Cc	90	90	1.0	90	10.0K			
43	11081-84	3	0.0	-1.0	1.1	0.1	2.725	49.0	48.7	2Cb	95	95	1.0	95	14.1K			
44	11084-85	1	0.1	-4.9	1.2	0.0	2.79	49.1	48.8	3Cd	120	120	1.0	120	12.2K			
45	11085-87	2	0.8	-0.1	1.9	0.9	2.72	49.9	49.6	2Cc	38	38	1.0	38	21.5			
46	11087-96	9	0.8	-2.1	1.9	0.0	2.75	50.0	49.7	3Cc	48	48	1.0	48	21.8K			
47	11096-11100	4	0.6	2.3	1.7	2.0	2.67	50.6	50.3	2Cb	42	42	1.0	42	103			
48	11100-03	3	0.6	-2.1	1.7	0.0	2.75	49.0	49.6	2Cb	50	50	1.0	50	19.0K			
49	11103-07	4	0.5	1.1	1.6	1.4	2.69	49.9	49.6	2Cb	60	60	1.0	60	123			
50	11107-09	2	0.5	-2.4	1.6	0.0	2.75	49.6	49.3	3Cc	70	70	1.0	70	16.0K			
51	11109-11	2	0.8	0.0	1.9	1.0	2.71	50.1	49.8	2Cc	55	55	1.0	55	180			
52	11111-13	2	0.5	-3.0	1.6	0.0	2.775	49.6	49.3	3Cc	80	80	1.0	80	15.0K			
53	11113-15	2	0.3	0.0	1.4	0.7	2.705	49.5	49.2	2Cb	80	80	1.0	80	214			
54	11115-17	2	0.3	-3.3	1.4	0.0	2.76	49.8	49.5	3Cc	80	80	1.0	80	15.0K			

Table E-41: Combined results of rock-typing and quantitative formation evaluation, Christianson #1-A, sesw 15-34N-57E.

Zone#	Depth	H	ØN	ØD	ØNC	Xplot	Ø	Pb	Δt	Δtc	Code	Rt	CF	Rtc	Sw%	DST	Perf.	By-passed OIP(MBO)
1	11056-64	8	-0.8	-10+	0.0	0.0	0.0	2.97	51.0	50.0	6Df	40K	1.0	40K	670			
2	11064-72	8	6.0	-5.0	6.8	0.9	0.9	2.785	47.4	46.4	4Ab	70	1.0	70	178			
3	11072-77	5	0.8	-8.5	1.6	0.0	0.0	2.85	43.7	42.7	5Ab	900	1.0	900	4.5K			
4	11077-80	3	1.3	-7.5	2.1	0.0	0.0	2.83	44.6	43.6	4Ab	500	1.0	500	6.0K			
5	11080-83	3	1.0	-9.7	1.8	0.0	0.0	2.88	44.0	43.0	5Ac	900	1.0	900	4.5K			
6	11083-85	2	4.7	-5.5	5.5	0.0	0.0	2.80	46.8	45.8	4Ab	150	1.0	150	11.0K			
7	11085-87	2	2.2	-7.4	3.0	0.0	0.0	2.83	45.3	44.3	4Ab	75	1.0	75	15.5K			
8	11087-89	2	5.4	-5.5	6.2	0.4	0.4	2.805	46.0	45.0	4Ab	150	1.0	150	273			
9	11089-91	2	19.4	4.0	20.2	14.1	0.0	2.65	56.0	55.0	6Ad	4	1.0	4	47			928
10	11091-93	2	3.6	3.0	4.4	3.7	0.0	2.665	51.2	50.2	2Bb	60	1.0	60	46			149
11	11093-96	3	2.0	2.0	2.8	2.4	0.0	2.68	52.6	51.6	2Cc	80	1.0	80	62			
12	11096-11102	6	1.5	-1.7	2.3	0.3	0.3	2.73	52.0	51.0	2Dd	140	1.0	140	377			
13	11102-06	4	22.3	6.9	23.1	15.0	0.0	2.60	64.2	63.2	5Df	2.8	1.0	2.8	53			
14	11106-08	2	16.0	6.0	16.8	11.4	0.0	2.615	60.0	59.0	4De	4	1.0	4	58			
15	11108-09	1	26.0	12.0	26.8	19.4	0.0	2.515	72.0	71.0	5Df	2.8	1.0	2.8	41			852
16	11109-11	2	19.7	0.0	20.5	10.3	0.0	2.71	58.7	57.7	5Df	4	1.0	4	65			
17	11111-14	3	19.7	2.4	20.5	11.5	0.0	2.67	58.6	57.6	5Cf	2.1	1.0	2.1	63			
18	11114-16	2	7.1	0.0	7.9	4.0	0.0	2.71	55.4	54.4	3De	41	1.0	41	52			
19	11116-20	4	12.0	1.3	12.8	7.1	0.0	2.685	57.5	56.5	4Df	16	1.0	16	47			
20	11120-22	2	7.0	20.0	7.8	13.9	0.0	2.71	56.0	55.0	6Ae	28	1.0	28	18			
21	11122-28	6	4.6	-1.0	5.4	2.2	0.0	2.725	53.1	52.1	3Dd	70	1.0	70	72			
22	11128-31	3	3.2	-3.6	4.0	0.0	0.0	2.77	51.0	50.0	3Cd	50	1.0	50	948			
23	11131-34	3	14.9	2.3	15.7	9.0	0.0	2.68	60.0	59.0	3Df	5	1.0	5	66			
24	11134-36	2	3.0	-2.9	3.8	0.5	0.5	2.76	49.8	48.8	3Cc	140	1.0	140	226			
25	11136-38	2	6.1	0.2	6.9	3.6	0.0	2.71	55.5	54.5	3De	40	1.0	40	58			
26	11138-39	1	4.5	-2.9	5.3	1.2	0.0	2.755	51.3	50.3	3Cd	70	1.0	70	133			
27	11139-40	1	24.0	7.8	24.8	16.3	0.0	2.585	63.5	62.5	3Df	1.8	1.0	1.8	86			
28	11140-42	2	0.6	-8.0	1.4	0.0	0.0	2.84	49.0	48.0	4Bd	70	1.0	70	1.6K			
29	11142-43	1	3.0	-1.7	4.8	1.1	0.0	2.74	50.1	49.1	3Cc	35	1.0	35	206			
30	11143-46	3	9.2	1.6	10.0	5.8	0.0	2.685	55.0	54.0	4Cd	5	1.0	5	103			
31	11146-53	7	7.2	-3.4	8.0	2.3	0.0	2.76	53.5	52.5	3De	7	1.0	7	220			
32	11153-60	7	8.0	-1.3	8.8	3.8	0.0	2.73	54.8	53.8	3De	5.5	1.0	5.5	175			
33	11160-62	2	4.3	-2.9	5.1	1.1	0.0	2.755	51.0	50.0	3Cd	10	1.0	10	385			
34	11162-64	2	10.0	1.0	10.8	5.9	0.0	2.70	54.5	53.5	4Cd	3.5	1.0	3.5	120			
35	11164-72	8	4.6	-2.6	5.4	1.4	0.0	2.75	52.7	51.7	3Dd	8	1.0	8	338			
36	11172-75	3	7.0	-1.2	7.8	3.3	0.0	2.73	53.4	52.4	3Dd	7.7	1.0	7.7	146			
37	11175-77	2	3.1	-3.3	3.9	0.3	0.0	2.76	51.9	50.9	3Dd	13	1.0	13	1.2K			
38	11177-80	3	8.0	1.0	8.8	4.9	0.0	2.70	55.5	54.5	3De	4.1	1.0	4.1	135			
39	11180-82	2	3.8	-3.2	4.6	0.7	0.0	2.76	51.0	50.0	3Cd	15	1.0	15	692			
40	11182-84	2	5.6	1.0	6.4	3.7	0.0	2.70	52.2	51.2	3Cc	9	1.0	9	120			
41	11184-86	2	2.5	-2.3	3.3	0.5	0.0	2.75	51.0	50.0	3Cc	19	1.0	19	615			
42	11186-87	1	4.0	0.0	4.8	2.4	0.0	2.715	51.5	50.5	3Cc	11	1.0	11	168			
43	11187-89	2	2.0	-1.7	2.8	0.6	0.0	2.73	50.8	49.8	2Cc	19	1.0	19	512			
44	11189-90	1	3.3	-0.9	4.1	1.6	0.0	2.72	51.0	50.0	2Cc	14	1.0	14	224			
45	11190-93	3	1.9	0.0	2.7	1.4	0.0	2.71	51.0	50.0	2Cc	30	1.0	30	174			
46	11193-95	2	1.7	-2.9	2.5	0.0	0.0	2.755	50.7	49.7	3Cc	32	1.0	32	23.7K			
47	11195-11200	5	2.5	0.4	3.3	1.9	0.0	2.71	50.8	49.8	2Cc	29	1.0	29	131			
48	11200-01	1	2.0	-2.5	2.8	0.2	0.0	2.75	50.8	49.8	3Cc	35	1.0	35	1.1K			
49	11201-04	3	1.2	1.0	2.0	1.5	0.0	2.695	50.2	49.2	2Cb	32	1.0	32	158			
50	11204-06	2	1.0	-2.2	1.8	0.0	0.0	2.75	50.2	49.2	3Cc	40	1.0	40	21.2K			
51	11206-08	2	1.0	1.0	1.8	1.4	0.0	2.70	50.7	49.7	2Cb	30	1.0	30	174			
52	11208-11	3	1.1	-1.7	1.9	0.1	0.0	2.73	50.9	49.9	2Cc	23	1.0	23	2.8K			
53	11211-13	2	1.2	0.2	2.0	1.2	0.0	2.70	51.2	50.2	2Cb	20	1.0	20	249			

Table E-42: Combined results of rock-typing and quantitative formation evaluation, Christensen #1, snw 22-34N-57E.

Zone#	Depth	H	ϕ_N	ϕ_D	ϕ_{Nc}	Xplot	ϕ	Pb	Δt	Δt_c	Code	Rt	CF	Rtc	Swt	DST	Perf.	By-passed OIP(MBO)
1	11064-73	8	-0.6	-10+	0.0	0.0	2.98	50.5	50.0	6Df	20K	1.0	1.0	20K	948			
2	11073-80	7	11.1	-1.6	11.7	5.1	2.735	48.2	47.7	4Ab	24	1.0	1.0	24	53			
3	11080-84	4	1.9	-7.6	2.5	0.0	2.835	46.0	45.5	4Ac	200	1.0	1.0	200	9.5K			
4	11084-87	3	13.7	0.0	14.3	7.2	2.71	51.4	50.9	4Ac	9	1.0	1.0	9	62			
5	11087-93	6	3.7	-8.3	4.3	0.0	2.85	44.5	44.0	5Ac	700	1.0	1.0	700	5.1K			549
6	11093-98	5	9.0	-3.1	9.6	3.3	2.76	47.2	46.7	4Ab	150	1.0	1.0	150	33			1,138
7	11098-11101	3	20.0	2.1	20.6	11.4	2.67	53.3	52.8	5Ac	12	1.0	1.0	12	33			198
8	11101-03	2	10.7	-4.0	11.3	3.7	2.775	48.5	48.0	4Ac	60	1.0	1.0	60	46			
9	11103-06	3	14.3	-1.2	14.9	6.9	2.73	50.5	50.0	4Ac	6	1.0	1.0	6	79			
10	11106-09	3	23.2	6.2	23.8	15.0	2.605	56.8	56.3	5Ad	3.1	1.0	1.0	3.1	50			1,117
11	11109-11	2	9.1	1.2	9.7	5.5	2.69	52.4	51.9	3Cc	100	1.0	1.0	100	21			415
12	11111-14	3	9.1	3.2	9.7	6.5	2.65	53.2	52.7	3Cc	90	1.0	1.0	90	21			765
13	11114-18	4	3.5	0.0	4.1	2.1	2.70	50.9	50.4	2Cc	60	1.0	1.0	60	82			
14	11118-21	3	6.6	4.0	7.2	5.6	2.65	53.3	52.8	2Cc	30	1.0	1.0	30	43			475
15	11121-26	5	6.0	0.0	6.6	3.3	2.705	51.4	50.9	3Cc	100	1.0	1.0	100	40			492
16	11126-32	6	19.0	7.9	19.6	13.8	2.585	60.3	59.8	4De	3.5	1.0	1.0	3.5	51			
17	11132-36	4	26.4	10.9	27.0	19.0	2.54	60.0	59.5	5Bd	2.2	1.0	1.0	2.2	47			2,000
18	11136-38	2	18.6	5.5	19.2	12.4	2.62	57.0	56.5	4Bd	3.0	1.0	1.0	3.0	62			
19	11138-41	3	21.1	6.1	21.7	13.9	2.61	58.3	57.8	5Ce	3.0	1.0	1.0	3.0	55			
20	11141-43	3	17.7	1.2	18.3	9.8	2.69	55.0	54.5	5Be	3.2	1.0	1.0	3.2	76			
21	11143-46	3	23.2	7.6	23.8	15.7	2.59	59.8	59.3	5Ce	17	1.0	1.0	17	20			1,559
22	11146-50	4	30.0	14.5	30.6	22.6	2.475	66.0	65.5	5Cf	17	1.0	1.0	17	14			
23	11150-53	3	9.2	0.9	9.8	5.9	2.70	55.8	55.3	4De	90	1.0	1.0	90	23		Yes	677
24	11153-55	2	24.5	13.8	25.1	19.5	2.495	62.7	62.2	5Cd	16	1.0	1.0	16	17		Yes	
25	11155-58	3	20.2	8.3	20.8	14.6	2.575	57.8	57.3	4Bd	17	1.0	1.0	17	22		Yes	
26	11158-61	3	27.1	9.2	27.7	18.5	2.56	59.2	58.7	5Ad	7	1.0	1.0	7	27		Yes	
27	11161-62	1	21.4	6.0	22.0	14.0	2.61	61.0	60.5	5Df	19	1.0	1.0	19	21		Yes	
28	11162-65	3	24.2	6.1	24.8	15.5	2.61	61.9	61.4	5Df	19	1.0	1.0	19	32		Yes	
29	11165-72	7	9.0	-0.5	9.6	4.6	2.72	51.0	50.5	3Bc	80	1.0	1.0	80	25		Yes	1,087
30	11172-76	4	17.7	3.0	18.3	10.7	2.655	56.0	55.5	4Cd	24	1.0	1.0	24	32		Yes	1,594
31	11176-79	3	24.0	11.0	24.6	17.8	2.53	64.8	64.3	6Cf	5.4	1.0	1.0	5.4	46		Yes	1,803
32	11179-82	3	31.2	12.3	31.8	22.2	2.505	64.9	64.4	6Cf	1.7	1.0	1.0	1.7	46		Yes	1,785
33	11182-85	3	16.0	2.0	16.6	9.3	2.675	54.0	53.5	4Bd	3	1.0	1.0	3	83			
34	11185-88	3	24.5	7.1	25.1	16.1	2.595	58.8	58.3	5Be	2.1	1.0	1.0	2.1	57			
35	11188-91	3	13.0	-0.7	13.6	6.5	2.725	50.9	50.4	4Ac	8.4	1.0	1.0	8.4	71			
36	11191-94	3	20.4	6.8	21.0	13.9	2.60	56.4	55.9	4Bc	2.5	1.0	1.0	2.5	61			
37	11194-11202	8	18.7	3.5	19.3	11.4	2.65	56.0	55.5	5Bd	3	1.0	1.0	3	67			
38	11202-05	3	25.2	7.1	25.8	16.5	2.60	56.2	55.7	5Ac	2.5	1.0	1.0	2.5	51			
39	11205-06	1	23.0	4.3	23.6	14.0	2.64	55.2	54.7	5Ad	2.5	1.0	1.0	2.5	60			
40	11206-10	4	24.5	8.4	25.1	16.8	2.57	59.0	58.5	5Bd	2	1.0	1.0	2	56			
41	11210-15	5	21.3	3.5	21.9	12.7	2.65	56.0	55.5	5Bd	3	1.0	1.0	3	60			
42	11215-17	2	23.0	6.9	23.6	15.3	2.60	60.0	59.9	5Ce	2	1.0	1.0	2	62			
43	11217-21	4	22.0	5.8	22.6	14.2	2.62	59.4	58.9	5Cf	2.1	1.0	1.0	2.1	65			
44	11221-24	3	24.1	9.9	24.7	17.3	2.55	60.6	60.1	5Ce	1.9	1.0	1.0	1.9	56			
45	11224-25	1	20.0	6.3	20.6	13.5	2.60	58.0	57.5	4Cd	2.2	1.0	1.0	2.2	67			
46	11225-27	2	24.6	6.3	25.2	15.8	2.60	58.0	57.5	5Bd	2.2	1.0	1.0	2.2	57			
47	11227-29	2	9.4	-0.2	10.0	4.9	2.71	54.9	54.4	3De	3.6	1.0	1.0	3.6	144			
48	11229-31	2	11.2	2.6	11.8	7.2	2.67	56.0	55.5	3De	3.5	1.0	1.0	3.5	99			
49	11231-34	3	2.9	-4.4	3.5	0.0	2.785	50.0	49.5	3Cd	23	1.0	1.0	23	28.0K			
50	11234-36	2	4.0	1.8	4.6	3.2	2.69	50.9	50.4	2Cb	20	1.0	1.0	20	93			
51	11236-37	1	2.8	-1.0	3.4	1.2	2.725	50.0	49.5	2Cc	30	1.0	1.0	30	204			
52	11237-39	2	3.0	0.3	3.6	1.7	2.70	50.0	49.5	2Cb	28	1.0	1.0	28	149			
53	11239-42	3	2.7	-3.9	3.3	0.0	2.76	49.7	49.2	3Cc	40	1.0	1.0	40	21.2K			

Table E-43: Combined results of rock-typing and quantitative formation evaluation, Haaven #1-25, nw/4 25-34N-58E.

Zone#	Depth	H	ϕ_N	ϕ_D	ϕ_{Nc}	Xplot	ϕ	Pb	Δt	Δt_{tc}	Code	Rt	CF	Rtc	Swi	DST	Perf.	By-passed OIP(NBO)
1	11204-10	8	-0.5	-10+	0.0	0.0	0.0	2.97	50.8	50.0	6Df	30K	1.0	30K	774	Yes		
2	11210-14	4	4.9	-5.8	5.4	0.0	0.0	2.80	46.6	45.8	4Ab	80	1.0	80	15.0K	Yes		
3	11214-20	6	1.2	-10.0	1.7	0.0	0.0	2.88	44.6	43.8	5Ac	150	1.0	150	11.0K	Yes		
4	11220-23	3	2.0	-8.0	2.5	0.0	0.0	2.845	45.0	44.2	4Ac	205	1.0	205	9.4K	Yes		
5	11223-28	5	1.0	-10.0	1.5	0.0	0.0	2.89	43.8	43.0	5Ac	710	1.0	710	5.0K	Yes		
6	11228-32	4	7.5	-5.0	8.0	1.5	1.5	2.79	46.6	45.8	4Ab	160	1.0	160	70	Yes	Yes	
7	11232-35	3	14.0	-0.5	14.5	7.0	7.0	2.715	51.9	51.1	4Bc	41	1.0	41	29	Yes	Yes	
8	11235-37	2	9.0	-3.5	9.5	3.0	3.0	2.76	49.5	48.7	4Bc	20	1.0	20	99	Yes	Yes	
9	11237-40	3	15.4	1.0	15.9	8.5	8.5	2.70	51.9	51.1	4Ac	8	1.0	8	55	Yes	Yes	
10	11240-43	3	23.1	9.2	23.6	16.4	16.4	2.565	56.8	56.0	4Ac	2.9	1.0	2.9	48	Yes	Yes	
11	11243-45	2	13.5	3.4	14.0	8.7	8.7	2.635	54.0	53.2	2Cc	12	1.0	12	69	Yes		570
12	11245-48	3	6.0	4.6	6.5	5.6	5.6	2.66	52.5	51.7	2Cb	26	1.0	26	90	Yes		
13	11248-56	8	2.0	3.3	2.5	2.9	2.9	2.66	52.5	51.7	2Cb	170	1.0	170	64	Yes		
14	11256-58	2	0.6	2.0	1.1	1.6	1.6	2.68	50.9	50.1	2Cb	23	1.0	23	51	Yes		
15	11258-61	3	5.1	5.2	5.6	5.4	5.4	2.625	54.0	53.2	2Cb	180	1.0	180	58	Yes		
16	11261-65	4	0.6	2.2	1.1	1.7	1.7	2.675	51.2	50.4	2Cb	15	1.0	15	72	Yes		
17	11265-70	5	6.0	3.0	6.5	4.8	4.8	2.66	53.5	52.7	2Cc	20	1.0	20	93	Yes		
18	11270-72	2	4.5	1.4	5.0	3.2	3.2	2.69	52.1	51.3	2Cc	4.3	1.0	4.3	72	Yes		
19	11272-75	3	12.5	4.8	13.0	8.9	8.9	2.635	57.0	56.2	3Cd	20	1.0	20	214	Yes		
20	11275-79	4	3.3	-1.2	4.0	1.4	1.4	2.73	51.8	51.0	3Dd	11	1.0	11	87	Yes		1,785
21	11279-80	1	6.5	2.1	7.0	4.6	4.6	2.675	53.9	52.9	2Cc	105	1.0	105	42	Yes		
22	11280-82	2	3.8	1.9	4.3	3.1	3.1	2.68	53.7	52.9	2Dc	34	1.0	34	62	Yes		
23	11282-85	3	4.1	2.8	4.6	3.7	3.7	2.66	56.3	55.5	2Dd	39	1.0	39	93	Yes		
24	11285-87	2	3.5	0.5	4.0	2.3	2.3	2.70	51.0	50.2	2Cb	28	1.0	28	72	Yes		
25	11287-89	2	5.4	1.1	5.9	3.5	3.5	2.69	52.0	51.2	2Cc	30	1.0	30	60	Yes		
26	11289-91	2	4.0	3.3	4.5	3.9	3.9	2.65	56.0	55.2	2Dd	69	1.0	69	115	Yes		
27	11291-93	2	1.6	0.6	2.1	1.4	1.4	2.70	52.0	51.2	2Dc	14	1.0	14	76	Yes		
28	11293-95	2	6.8	2.0	7.3	4.7	4.7	2.675	53.8	53.0	3Cc	18	1.0	18	137	Yes		
29	11295-99	4	3.9	0.2	4.4	2.3	2.3	2.71	52.5	51.7	2Dc	17	1.0	17	95	Yes		
30	11299-11300	1	5.4	0.8	5.9	3.4	3.4	2.725	52.0	51.2	3Dd	100	1.0	100	78	Yes		
31	11300-05	5	2.1	-0.8	2.6	1.7	1.7	2.70	53.7	52.9	3Dd	42	1.0	42	98	Yes		
32	11305-06	1	3.6	0.1	4.1	2.1	2.1	2.70	50.9	50.1	2Cb	90	1.0	90	94	Yes		
33	11306-08	2	2.3	-0.2	2.8	1.5	1.5	2.715	50.1	49.3	2Cb	17	1.0	17	49	Yes		261
34	11308-11	3	4.5	2.0	5.0	3.5	3.5	2.675	56.0	55.2	2Dc	105	1.0	105	13.1K	Yes		334
35	11311-13	2	8.0	4.7	8.5	6.6	6.6	2.635	58.4	57.6	2Dc	105	1.0	105	13.1K	Yes		
36	11313-16	3	1.0	-1.5	1.5	0.0	0.0	2.735	49.9	49.1	2Cc	105	1.0	105	13.1K	Yes		
37	11316-20	4	3.2	0.6	3.7	2.2	2.2	2.70	52.0	51.2	2Cc	10	1.0	10	192	Yes		
38	11320-22	2	0.9	0.0	1.4	0.7	0.7	2.71	49.8	49.0	2Cb	29	1.0	29	355	Yes		
39	11322-25	3	1.0	0.2	1.5	0.9	0.9	2.70	50.1	49.3	2Cb	29	1.0	29	276	Yes		
40	11325-29	4	1.0	-2.0	1.5	0.0	0.0	2.74	50.1	49.3	2Cc	40	1.0	40	21.2K	Yes		
41	11329-31	2	2.9	-0.2	3.4	1.6	1.6	2.715	51.4	50.6	2Cc	14	1.0	14	224	Yes		
42	11331-33	2	2.7	-0.8	3.2	1.2	1.2	2.725	51.9	51.1	2Dc	14	1.0	14	298	Yes		
43	11333-36	3	4.3	0.9	4.8	2.9	2.9	2.70	52.3	51.5	2Cc	7	1.0	7	174	Yes		
44	11336-41	5	3.0	-0.1	3.5	1.7	1.7	2.715	50.0	49.2	2Cb	9	1.0	9	263	Yes		
45	11341-43	2	7.4	0.6	7.9	4.3	4.3	2.70	54.3	53.5	3Dd	4	1.0	4	156	Yes		
46	11343-45	2	3.6	-0.9	4.1	1.6	1.6	2.73	52.0	51.2	3Dd	9.5	1.0	9.5	272	Yes		
47	11345-47	2	4.8	0.7	5.3	3.0	3.0	2.70	52.7	51.9	2Cc	13	1.0	13	150	Yes		
48	11347-50	3	2.4	0.4	2.9	1.7	1.7	2.70	52.0	51.2	2Cc	26	1.0	26	877	Yes		
49	11350-53	3	1.0	-0.9	1.5	0.3	0.3	2.725	51.0	50.2	2Dc	26	1.0	26	877	Yes		

Table E-44 Combined results of rock-typing and quantitative formation evaluation, Morken #1, swne 27-34N-58E.

Zone#	Depth	H	ØN	ØD	ØNC	Xplot	Ø	Pb	Δt	Δtc	Code	Rt	CP	Rtc	Swi	DST	Perf.	By-passed OIP(MBO)
1	11194-11202	8	-0.8	-10+	0.0	0.0	0.0	2.99	50.3	50.0	6df	30K	1.0	30K	774			
2	11202-08	6	11.0	-2.3	11.8	4.8	2.75	49.0	48.7	4Ac	18	1.0	1.0	18	65			
3	11208-11	3	5.6	-6.0	6.4	0.2	2.82	46.0	45.7	4Ac	100	1.0	1.0	100	670			
4	11211-15	4	26.0	10.0	26.8	18.4	2.55	60.0	59.7	5Bd	2	1.0	1.0	2	51			
5	11215-18	3	30.0	18.4	30.8	24.6	2.415	75.9	75.6	4Df	1.0	1.0	1.0	1.0	54	Yes		
6	11218-23	5	5.0	-5.0	5.8	0.4	2.80	50.3	50.0	4Cd	20	1.0	1.0	20	749	Yes		
7	11223-28	5	30.3	11.0	31.1	21.1	2.53	65.1	64.8	6Df	1.7	1.0	1.0	1.7	48	Yes		2,724
8	11228-30	2	18.0	4.0	18.8	11.4	2.65	55.1	54.8	5Bd	8	1.0	1.0	8	41			653
9	11230-32	2	21.0	7.5	21.8	14.7	2.59	58.0	57.7	4Bd	2.7	1.0	1.0	2.7	55			
10	11232-35	3	0.1	-0.9	0.9	0.0	2.72	49.4	49.1	2Cb	600	1.0	1.0	600	5.5K			
11	11235-37	2	1.0	1.0	1.8	1.4	2.685	50.4	50.1	2Cb	150	1.0	1.0	150	78			
12	11237-41	4	1.0	-2.0	1.8	0.0	2.75	49.5	49.2	3Cc	110	1.0	1.0	110	12.8K			
13	11241-56	15	1.5	1.0	2.3	1.7	2.70	52.0	51.7	2Dc	30	1.0	1.0	30	144			
14	11256-58	2	0.8	-1.3	1.6	0.2	2.73	50.0	49.7	2Cc	140	1.0	1.0	140	566			
15	11258-60	2	4.4	1.7	5.2	3.5	2.66	52.0	51.7	2Cb	17	1.0	1.0	17	92			
16	11260-62	2	4.4	-1.0	5.2	2.1	2.735	52.0	51.7	3Dd	17	1.0	1.0	17	154			
17	11262-66	4	8.0	3.8	8.8	6.3	2.65	55.0	54.7	3Dd	6	1.0	1.0	6	86			
18	11266-68	2	4.4	-2.7	5.2	1.3	2.75	52.0	51.7	3Dd	9	1.0	1.0	9	344			
19	11268-70	2	12.1	1.7	12.9	7.3	2.69	55.5	55.2	4De	4	1.0	1.0	4	91			
20	11270-74	4	2.0	-3.8	2.8	0.0	2.76	49.6	49.3	3Cc	40	1.0	1.0	40	21.2K			
21	11274-77	3	3.6	-0.8	4.4	1.8	2.72	51.0	50.7	2Cc	28	1.0	1.0	28	140			
22	11277-79	2	5.7	1.0	6.5	3.8	2.70	57.0	56.7	3Df	18	1.0	1.0	18	83			
23	11279-84	5	2.5	-2.4	3.3	0.5	2.75	51.3	51.0	3Df	90	1.0	1.0	90	282			
24	11284-86	2	3.9	2.8	4.7	3.8	2.665	57.0	56.7	2De	45	1.0	1.0	45	52			
25	11286-90	4	1.8	-2.1	2.6	0.3	2.77	50.9	50.6	3Dd	90	1.0	1.0	90	471			
26	11290-92	2	5.4	1.2	6.2	3.7	2.69	52.0	51.7	3Cc	16	1.0	1.0	16	90			
27	11292-94	2	2.5	-2.7	3.3	0.3	2.75	51.0	50.7	3Dd	21	1.0	1.0	21	975			
28	11294-96	2	4.5	1.0	5.3	3.2	2.725	52.0	51.7	3Cd	18	1.0	1.0	18	98			
29	11296-98	2	3.9	-3.9	4.7	0.4	2.77	50.9	50.6	3Dd	25	1.0	1.0	25	670			
30	11298-11302	4	2.9	-1.1	3.7	1.3	2.73	52.1	51.8	3Dd	75	1.0	1.0	75	119			
31	11302-04	2	1.9	-5.0	2.7	0.0	2.79	50.0	49.7	3Cd	140	1.0	1.0	140	11.3K			
32	11304-05	1	4.5	1.7	5.3	3.5	2.685	56.2	55.9	2De	65	1.0	1.0	65	47			
33	11305-07	2	4.2	-2.8	5.0	1.1	2.75	51.5	51.2	3Dd	65	1.0	1.0	65	151			
34	11307-08	1	6.2	1.6	7.0	4.3	2.685	58.0	57.7	3Df	30	1.0	1.0	30	56			
35	11308-11	3	1.9	-2.6	2.7	0.1	2.75	50.0	49.7	3Cc	90	1.0	1.0	90	1.4K			
36	11311-14	3	6.0	-3.8	6.8	1.5	2.765	52.0	51.7	3De	9	1.0	1.0	9	298			
37	11314-17	3	3.0	0.7	3.8	2.3	2.75	51.0	50.7	3Cd	20	1.0	1.0	20	130			
38	11317-19	2	1.1	-1.8	1.9	0.1	2.735	49.9	49.6	2Cc	53	1.0	1.0	53	1.8K			
39	11319-22	3	0.6	-2.0	1.4	0.6	2.72	50.0	49.7	2Cc	40	1.0	1.0	40	353			
40	11322-29	7	1.0	-4.2	1.8	0.0	2.78	50.0	49.7	3Cd	87	1.0	1.0	87	14.4K			
41	11329-31	2	1.8	-2.0	2.6	0.3	2.74	50.1	49.8	2Cc	27	1.0	1.0	27	860			
42	11331-34	3	1.0	-3.7	1.8	0.0	2.765	50.0	49.7	3Cd	33	1.0	1.0	33	23.4K			
43	11334-39	5	3.0	1.0	3.8	2.4	2.70	51.5	51.2	2Cc	10	1.0	1.0	10	176			
44	11339-45	6	1.8	-4.0	2.6	0.0	2.77	50.0	49.7	3Cd	23	1.0	1.0	23	28.0K			
45	11345-48	3	1.0	-1.3	1.8	0.3	2.73	49.7	49.4	2Cc	35	1.0	1.0	35	755			
46	11348-50	2	3.6	-3.0	4.4	1.7	2.755	52.0	51.7	3Dd	15	1.0	1.0	15	494			
47	11350-52	2	2.4	-2.3	3.2	0.5	2.75	50.4	50.1	3Cc	20	1.0	1.0	20	599			
48	11352-53	1	4.0	0.1	4.8	2.8	2.70	52.0	51.7	2Cc	123	1.0	1.0	12	154			
49	11353-55	2	2.0	-1.8	2.8	0.5	2.73	50.6	50.3	2Dc	30	1.0	1.0	30	489			
50	11355-57	2	3.9	0.0	4.7	2.4	2.71	52.0	51.7	2Dc	10	1.0	1.0	10	176			
51	11357-61	4	1.8	-1.6	2.6	0.5	2.735	51.0	50.7	2Dc	25	1.0	1.0	25	536			
52	11361-64	3	1.9	0.9	2.7	1.8	2.70	51.1	50.8	2Cc	20	1.0	1.0	20	166			
53	11364-70	6	1.2	-3.5	2.0	0.0	2.76	50.4	50.1	3Dd	36	1.0	1.0	36	22.4K			
54	11370-73	3	1.0	0.0	1.8	0.9	2.715	50.3	50.0	2Cc	30	1.0	1.0	30	272			
55	11373-76	3	1.0	-2.3	1.8	0.0	2.75	50.5	50.2	3Dd	50	1.0	1.0	50	19.0K			
56	11376-80	4	0.9	0.0	1.7	0.9	2.715	50.3	50.0	2Cc	40	1.0	1.0	40	235			

Table E-45: Combined results of rock-typing and quantitative formation evaluation, Harshbarger #5-29, swnw 29-34N-58E.

Zone#	Depth	H	ϕ_N	ϕ_D	ϕ_{Nc}	Xplot	ϕ	Pb	Δt	Δt_c	Code	Rt	CF	Rtc	Sw%	DST	Perf.	By-passed OIP(MBO)
1	11100-09	9	-0.8	-10+	0.0	0.0	0.0	2.965	54.0	50.0	6Df	13K	1.0	13K	1.2K			
2	11109-13	4	8.9	-2.0	9.7	3.9	3.9	2.74	50.9	46.9	4Ab	32	1.0	32	60			
3	11113-16	3	2.7	-7.6	3.5	0.0	0.0	2.825	48.4	44.4	4Ab	160	1.0	160	10.6K			
4	11116-18	2	3.2	-5.9	4.0	0.0	0.0	2.80	49.2	45.2	4Ab	120	1.0	120	12.2K			
5	11118-22	4	2.0	-8.2	2.8	0.0	0.0	2.845	47.9	43.9	4Ab	1.1K	1.0	1.1K	4.0K			
6	11122-24	2	2.6	-6.7	3.4	0.0	0.0	2.82	48.0	44.0	4Ab	1.0K	1.0	1.0K	4.2K			
7	11124-26	2	2.0	-8.0	2.8	0.0	0.0	2.84	47.3	43.3	4Ab	300	1.0	300	7.7K			
8	11126-29	3	5.8	-3.1	6.6	1.8	1.8	2.76	49.7	45.7	3Ab	90	1.0	90	78			
9	11129-32	3	4.0	-5.4	4.8	0.0	0.0	2.80	49.0	45.0	4Ab	680	1.0	680	5.1K			
10	11132-34	2	9.5	-2.5	10.3	3.9	3.9	2.75	51.5	47.5	4Ab	22	1.0	22	73			
11	11134-37	3	8.0	-4.0	8.8	2.4	2.4	2.775	50.0	46.0	4Ab	70	1.0	70	66			
12	11137-41	4	16.7	1.3	17.5	9.4	9.4	2.69	55.6	51.6	5Ac	4.8	1.0	4.8	65			
13	11141-45	4	20.6	9.3	21.4	15.4	15.4	2.56	60.9	56.9	4Bc	2.2	1.0	2.2	58			
14	11145-48	3	3.1	3.1	3.9	3.5	3.5	2.665	55.7	51.7	2Cb	16	1.0	16	95			
15	11148-50	2	4.3	4.3	5.1	4.7	4.7	2.64	56.6	52.6	2Cb	15	1.0	15	73	Yes		
16	11150-52	2	2.3	2.3	3.1	2.7	2.7	2.675	54.9	50.9	2Cb	21	1.0	21	108	Yes		
17	11152-53	1	4.3	2.3	5.1	3.7	3.7	2.675	55.5	51.5	2Cc	20	1.0	20	81	Yes		
18	11153-56	3	3.8	2.0	4.6	3.3	3.3	2.685	54.5	50.5	2Cb	62	1.0	62	51	Yes		
19	11156-62	6	20.0	7.0	20.8	13.9	13.9	2.60	62.0	58.0	4Cd	2.3	1.0	2.3	63	Yes		
20	11162-66	4	26.5	11.3	27.3	19.3	19.3	2.525	60.9	62.9	5Cf	1.5	1.0	1.5	56	Yes		
21	11166-71	5	19.0	6.1	19.8	13.0	13.0	2.61	61.0	57.0	4Bd	2.4	1.0	2.4	66	Yes		
22	11171-74	3	24.0	11.7	24.8	18.3	18.3	2.525	61.6	59.6	4Bd	2	1.0	2	51	Yes		
23	11174-77	3	19.7	4.0	20.5	12.3	12.3	2.65	58.4	54.4	5Ad	3	1.0	3	62	Yes		
24	11177-79	2	26.9	9.7	27.7	18.7	18.7	2.55	63.0	63.0	5Cf	1.2	1.0	1.2	65	Yes		
25	11179-81	2	9.7	4.0	10.5	7.3	7.3	2.65	59.5	54.5	3Cd	10	1.0	10	58	Yes		
26	11181-82	1	13.1	4.4	13.9	9.2	9.2	2.64	62.5	58.5	3Df	5	1.0	5	65	Yes		
27	11182-87	5	7.0	2.4	7.8	5.1	5.1	2.67	58.4	52.4	3Cc	20	1.0	20	58	Yes		
28	11187-89	2	9.0	3.4	9.8	6.6	6.6	2.65	56.5	52.5	3Bc	10	1.0	10	64	Yes		
29	11189-95	6	6.0	1.0	6.8	3.9	3.9	2.70	55.8	51.8	3Cc	18	1.0	18	81	Yes		
30	11195-11200	5	22.9	11.1	23.7	17.4	17.4	2.53	67.3	63.3	4Df	1.6	1.0	1.6	60	Yes		
31	11200-04	4	6.0	1.0	6.8	3.9	3.9	2.70	57.8	53.8	3Dd	10.1	1.0	10.1	108	Yes		
32	11204-05	1	15.5	3.8	16.3	10.1	10.1	2.65	59.5	55.5	4Cd	4.5	1.0	4.5	62	Yes		
33	11205-07	2	6.8	2.0	7.6	4.8	4.8	2.68	56.4	52.4	3Cc	28	1.0	28	52	Yes		
34	11207-08	1	18.9	3.5	19.7	11.6	11.6	2.65	62.0	58.0	5Cf	4	1.0	4	57	Yes		
35	11208-10	2	18.9	3.0	19.7	11.4	11.4	2.615	58.9	54.9	4Bd	4	1.0	4	58	Yes		
36	11210-11	1	22.3	11.0	23.1	17.1	17.1	2.535	67.5	63.5	4Df	1.8	1.0	1.8	64	Yes		
37	11211-13	2	21.7	8.5	22.5	15.5	15.5	2.58	65.0	61.0	5Df	1.8	1.0	1.8	63	Yes		
38	11213-15	2	26.0	13.3	26.8	20.1	20.1	2.49	66.1	62.1	3Cd	1.1	1.0	1.1	63	Yes		
39	11215-17	2	21.4	5.5	22.2	13.9	13.9	2.625	61.0	57.0	5Bd	1.6	1.0	1.6	76	Yes		
40	11217-19	2	24.1	8.9	24.9	16.9	16.9	2.57	63.0	59.0	5Bd	1.2	1.0	1.2	72	Yes		
41	11219-21	2	22.0	4.0	22.8	13.4	13.4	2.65	61.0	57.0	5Be	1.8	1.0	1.8	74	Yes		
42	11221-23	2	26.0	9.0	26.8	17.9	17.9	2.57	67.6	63.6	5Df	1.2	1.0	1.2	68	Yes		
43	11223-26	3	10.6	1.8	11.4	6.6	6.6	2.685	58.6	54.6	3Cd	5.5	1.0	5.5	86	Yes		
44	11226-29	3	5.8	-1.4	6.6	2.6	2.6	2.73	54.8	50.8	3Cc	13	1.0	13	143	Yes		
45	11229-32	3	7.3	2.3	8.1	5.2	5.2	2.67	57.9	53.9	3Dd	6.2	1.0	6.2	123	Yes		
46	11232-34	2	7.2	0.2	8.0	4.1	4.1	2.70	57.7	53.7	3Dd	7	1.0	7	123	Yes		
47	11234-35	1	8.0	1.5	8.8	5.2	5.2	2.68	58.2	54.2	3Dd	6	1.0	6	105	Yes		

Table E-46: Combined results of rock-typing and quantitative formation evaluation, Ross #11-3, new 3-158N-102W.

Zone#	Depth	H	K _W	ØD	ØNc	Xplot Ø	Pb	Δt	Δtc	Code	Rt	CF	Rtc	Sw#	DST Perf.	By-passed OIP(MBO)
1	12370-77	7	-0.9	-10+	0.0	0.0	2.975	50.1	50.0	6Df	35K	1.0	35K	717		
2	12377-79	2	2.7	-7.3	3.6	0.0	2.83	46.0	45.9	4Ac	390	1.0	390	6.8K		
3	12379-81	2	1.8	-8.0	2.7	0.0	2.84	44.7	44.6	4Ac	390	1.0	390	6.8K		
4	12381-86	5	4.0	-4.0	4.9	0.5	2.78	47.0	46.9	3Bc	140	1.0	140	226		
5	12386-89	3	0.9	-6.7	1.8	0.0	2.82	44.6	44.5	4Ab	400	1.0	400	6.7K		
6	12389-90	1	2.3	-6.0	3.2	0.0	2.805	44.6	44.5	4Ab	120	1.0	120	12.2K		
7	12390-93	3	1.7	-7.5	2.6	0.0	2.83	44.0	43.9	4Ab	430	1.0	430	6.5K		
8	12393-97	4	2.5	-4.0	3.4	0.0	2.775	46.9	46.8	3Bb	430	1.0	430	6.5K		
9	12397-12401	4	1.6	-7.3	2.5	0.0	2.83	44.9	44.8	4Ac	4.0K	1.0	4.0K	5.1K		
10	12401-05	4	4.0	-3.8	4.9	0.6	2.765	46.7	46.6	3Bb	200	1.0	200	158		
11	12405-07	2	1.1	-5.3	2.0	0.0	2.80	45.5	45.4	4Ab	610	1.0	610	5.4K		
12	12407-10	3	5.4	-2.7	6.3	1.8	2.75	47.0	46.5	3Ab	60	1.0	60	96		
13	12410-14	4	3.0	-5.1	3.9	0.0	2.795	46.0	45.9	3Ab	90	1.0	90	14.1K		
14	12414-18	4	6.9	-1.0	7.8	3.4	2.73	49.3	49.2	3Bc	43	1.0	43	60		
15	12418-20	2	4.8	-4.0	5.7	0.9	2.765	47.3	47.2	3Bb	68	1.0	68	180		
16	12420-23	3	12.7	0.0	13.6	6.8	2.70	52.0	51.9	4Bc	13	1.0	13	54		
17	12423-25	2	10.0	-1.7	10.9	4.6	2.73	50.6	50.5	4Bc	20	1.0	20	65		
18	12425-28	3	11.0	0.6	11.9	6.3	2.70	51.7	51.6	4Bc	25	1.0	25	42		544
19	12428-33	5	5.0	-1.7	5.9	2.1	2.77	47.8	47.7	4Bc	51	1.0	51	89		
20	12433-36	3	7.1	-1.8	8.0	3.2	2.74	50.0	49.9	3Bc	30	1.0	30	76		
21	12436-39	3	4.2	-4.0	5.1	0.6	2.77	47.4	47.3	3Bc	100	1.0	100	223		
22	12439-40	1	4.7	-3.4	5.6	1.1	2.765	48.0	47.9	3Bc	100	1.0	100	121		
23	12440-43	3	3.8	-7.1	4.7	0.0	2.825	46.3	46.2	4Bc	100	1.0	100	13.4K		
24	12443-46	3	9.1	-2.0	10.0	4.0	2.695	47.7	47.6	3Aa	130	1.0	130	29		352
25	12446-49	3	1.3	-6.4	2.2	0.0	2.815	45.9	45.8	4Ac	800	1.0	800	4.7K		968
26	12449-54	5	12.1	-1.0	13.0	6.0	2.725	48.1	48.0	4Ab	40	1.0	40	35		
27	12454-55	1	6.0	-2.9	6.9	2.0	2.75	48.0	47.9	3Bb	40	1.0	40	106		
28	12455-58	3	6.2	0.0	7.1	3.6	2.71	48.5	48.4	3Ab	40	1.0	40	58		
29	12458-62	4	4.7	-2.5	5.6	1.6	2.75	47.4	47.3	3Bb	240	1.0	240	54		306
30	12462-64	2	8.0	-0.2	8.9	4.4	2.715	48.0	47.9	3Ab	100	1.0	100	30		
31	12464-65	1	6.8	-2.9	7.7	2.4	2.75	47.8	47.7	3Bb	105	1.0	105	54		329
32	12465-67	2	10.8	-2.5	11.7	4.6	2.75	48.0	48.6	4Ac	105	1.0	105	28		845
33	12467-69	2	6.0	-4.0	6.9	1.5	2.775	48.0	47.9	4Bc	80	1.0	80	34		
34	12469-75	6	10.3	-2.7	11.2	4.3	2.75	49.1	49.0	4Bc	270	1.0	270	54		
35	12475-79	4	6.0	-5.7	6.9	0.6	2.80	47.5	47.4	4Bc	100	1.0	100	223		
36	12479-81	2	7.6	-3.5	8.5	2.5	2.77	48.0	47.9	4Bc	90	1.0	90	56		
37	12481-83	2	3.9	-6.6	4.8	0.0	2.815	46.5	46.4	4Bc	380	1.0	380	6.9K		217
38	12483-88	5	7.4	-4.5	8.3	1.9	2.78	48.0	47.9	4Bc	200	1.0	200	49		
39	12488-90	2	4.5	-5.9	5.4	0.0	2.80	46.6	46.5	4Bc	810	1.0	810	4.7K		
40	12490-93	3	6.5	-4.1	7.4	1.7	2.775	47.0	46.9	4Ab	200	1.0	200	55		
41	12493-94	1	3.3	-5.9	4.2	0.0	2.80	46.7	46.6	4Bc	305	1.0	305	7.7K		
42	12494-96	2	6.6	-4.6	7.5	1.5	2.78	47.4	47.3	4Bc	95	1.0	95	91		
43	12496-97	1	5.5	-6.0	6.4	0.2	2.81	47.1	47.0	4Bc	95	1.0	95	688		
44	12497-12501	4	7.4	-5.0	8.3	1.7	2.79	47.8	47.7	4Bc	58	1.0	58	103		
45	12501-03	2	4.2	-6.7	5.1	0.0	2.815	46.8	46.7	4Bc	98	1.0	98	13.6K		
46	12503-05	2	6.0	-3.0	6.9	2.0	2.755	47.4	47.3	3Ab	87	1.0	87	71		
47	12505-06	1	6.0	-5.3	6.9	0.8	2.80	46.7	46.6	4Bc	92	1.0	92	174		
48	12506-09	3	8.0	-3.7	8.9	2.6	2.775	46.8	46.7	4Ab	80	1.0	80	57		
49	12509-16	7	4.5	-5.2	5.4	0.1	2.80	47.0	46.9	4Bc	100	1.0	100	1.3K		352
50	12516-17	1	8.4	-3.0	9.3	3.2	2.755	47.0	46.9	4Ab	48	1.0	48	60		
51	12517-20	3	5.5	-7.0	6.4	0.0	2.82	46.2	46.1	4Bc	130	1.0	130	11.8K		
52	12520-21	1	7.1	-4.0	8.0	2.0	2.775	47.2	47.1	4Ac	80	1.0	80	74		
53	12521-23	2	4.3	-6.0	5.2	0.0	2.80	46.8	46.7	4Bc	110	1.0	110	12.8K		
54	12523-26	3	6.1	-2.4	7.0	2.3	2.75	47.6	47.5	3Ab	60	1.0	60	75		

Table E-47: Combined results of rock-typing and quantitative formation evaluation, Eddy Mitchell #11-21, new 21-158N-1024.

Zone#	Depth	H	ρ_N	ρ_D	ρ_{NC}	Xplot ϕ	Pb	Δt	Δt_c	Code	Rt	CP	Rtc	Sw%	DST	Perf.	By-passed OIP(MBO)
1	12627-34	7	-1.0	-10+	0.0	0.0	2.975	51.2	50.0	6Df	40K	1.0	40K	670			
2	12634-35	1	5.0	-3.9	6.0	1.1	2.77	48.0	46.8	3Bb	70	1.0	70	145			
3	12635-37	2	4.5	-5.3	5.5	0.1	2.795	47.5	46.3	3Bc	80	1.0	80	1.5K			
4	12637-38	1	5.8	-4.0	6.8	1.4	2.77	48.9	47.7	3Bc	56	1.0	56	128			
5	12638-41	3	3.1	-5.2	4.1	0.0	2.79	47.5	46.3	3Bb	50	1.0	50	18.0K			
6	12641-45	4	7.4	-0.1	8.4	4.2	2.71	50.0	48.8	3Ab	22	1.0	22	68			
7	12645-48	3	5.9	-2.0	6.9	2.5	2.745	47.3	46.1	3Ab	60	1.0	60	69			
8	12648-52	4	6.0	-3.9	7.0	1.6	2.77	49.0	47.8	3Bc	33	1.0	33	145			
9	12652-57	5	7.9	0.1	8.9	4.5	2.705	50.3	49.1	3Bb	22	1.0	20	71			
10	12657-60	3	6.6	-2.0	7.6	2.8	2.745	49.9	48.7	3Bc	55	1.0	55	64			
11	12660-65	5	10.0	0.2	11.0	5.6	2.705	51.0	49.8	4Ab	16	1.0	16	59			
12	12665-66	1	3.6	-0.2	4.6	2.2	2.71	47.3	46.1	2Aa	180	1.0	180	45			30
13	12666-68	2	9.4	0.5	10.4	5.5	2.70	48.8	47.6	3Aa	85	1.0	85	26			404
14	12668-71	3	4.0	-3.1	5.0	1.0	2.76	48.0	46.8	3Bb	105	1.0	105	130			
15	12671-73	2	7.7	1.2	8.7	5.0	2.695	50.0	48.8	3Ab	75	1.0	75	30			348
16	12673-77	4	6.5	-2.8	7.5	2.4	2.75	50.5	48.8	3Bc	75	1.0	75	64			
17	12677-85	8	10.0	1.4	11.0	6.2	2.695	51.7	50.5	4Bc	21	1.0	21	47			1,305
18	12685-89	4	3.7	-4.6	4.7	0.1	2.79	48.0	46.8	3Bc	70	1.0	70	1.6K			
19	12689-92	3	6.5	-0.3	7.5	3.6	2.72	49.4	48.2	3Ab	25	1.0	25	74			
20	12692-94	2	6.1	-3.5	7.1	1.8	2.76	49.4	48.2	3Bc	25	1.0	25	149			
21	12694-96	2	9.9	0.9	10.9	5.9	2.695	5.2	50.0	3Ab	9	1.0	9	75			
22	12696-12700	4	5.6	-3.0	6.6	1.8	2.755	48.3	47.1	3Ab	80	1.0	80	83			
23	12700-02	2	9.4	-0.2	10.4	5.1	2.715	50.0	48.8	4Ab	50	1.0	50	37			319
24	12702-04	2	4.1	-4.5	5.1	0.3	2.79	47.2	46.0	3Ab	120	1.0	120	406			
25	12704-09	5	8.9	-0.4	9.9	4.8	2.72	50.0	48.8	4Ab	20	1.0	20	62			
26	12709-14	5	4.0	-3.0	5.0	1.0	2.755	48.0	46.8	3Bb	50	1.0	50	189			
27	12714-16	2	5.0	-1.9	6.0	2.1	2.735	49.5	48.3	3Bb	47	1.0	47	93			
28	12716-19	3	3.5	-2.9	4.5	0.8	2.75	47.3	46.1	3Ab	140	1.0	140	141			
29	12719-20	1	9.0	1.5	10.0	5.8	2.685	49.0	47.8	3Aa	57	1.0	57	30			302
30	12720-24	4	8.0	-2.0	9.0	3.5	2.74	49.0	47.8	3Ab	61	1.0	61	49			310
31	12724-30	6	9.0	0.0	10.0	5.0	2.71	49.8	48.6	3Ab	40	1.0	40	42			864
32	12730-32	2	7.1	-2.0	8.1	3.1	2.74	48.9	47.7	3Ab	23	1.0	23	90			
33	12732-35	3	12.0	-0.5	13.0	6.3	2.72	50.0	48.8	4Ab	18	1.0	18	50			154
34	12735-38	3	8.0	-2.0	9.0	3.5	2.75	50.0	48.8	4Bc	10	1.0	10	121			
35	12738-42	4	10.3	2.0	11.3	6.7	2.68	52.0	50.8	3Bb	10	1.0	10	63			
36	12742-45	3	2.1	-3.6	3.1	0.0	2.77	49.1	47.9	3Bc	100	1.0	100	13.4K			
37	12745-50	5	8.6	-0.3	9.6	4.7	2.72	51.6	50.4	3Bc	11	1.0	11	86			
38	12750-53	3	0.3	-3.9	1.3	0.0	2.77	48.0	47.6*	3Bc	90	1.0	90	14.1K			
39	12753-60	7	0.2	-2.1	1.2	0.0	2.75	49.0	48.6*	3Cc	190	1.0	190	9.7K			
40	12760-64	4	0.2	-2.3	1.2	0.0	2.75	48.1	47.7*	3Bb	110	1.0	110	12.8K			
41	12764-67	3	0.2	-1.1	1.2	0.1	2.72	49.3	48.9*	2Cb	90	1.0	90	1.4K			
42	12767-70	3	0.4	-4.0	1.4	0.0	2.775	49.2	48.8*	3Cc	120	1.0	120	12.2K			
43	12770-77	7	0.8	-2.1	1.8	0.0	2.75	49.2	48.8*	3Cc	45	1.0	45	20.0K			
44	12777-80	3	0.6	-3.9	1.6	0.0	2.78	49.0	48.6*	3Cc	26	1.0	26	26.3K			
45	12780-82	2	1.9	-2.1	2.9	0.4	2.745	50.0	49.6*	3Cc	55	1.0	55	452			
46	12782-90	8	0.4	-3.0	1.4	0.0	2.75	48.9	48.5*	3Cc	190	1.0	190	9.7K			
47	12790-97	7	1.8	-1.2	2.8	0.8	2.73	50.0	49.6*	2Cc	30	1.0	30	306			
48	12797-99	2	0.7	-2.1	1.7	0.0	2.75	49.4	49.0*	3Cc	60	1.0	60	17.3K			
49	12799-12801	2	1.2	-1.3	2.2	0.5	2.73	50.0	49.6*	2Cc	30	1.0	30	489			

* Interval transit-time corrected by subtracting 0.4 usec/ft instead of 1.2 usec/ft in the preceding zones.

Table E-48: Combined results of rock-typing and quantitative formation evaluation, #1 Pasternak #33-13, nws 33-158N-102W.

Zone#	Depth	H	ØN	ØD	ØNc	Xplot	Ø	Pb	Δt	Δtc	Code	Rt	CP	Rtc	Swt	DST	Perf.	By-passed OIP(MBO)
1	12790-98	8	0.0	-10+	0.0	0.0	2.97	50.0	50.0	6Df	410	410	1.0	410	6.6K			
2	12798-12800	2	12.8	-0.3	12.8	6.3	2.725	48.0	48.0	4Ab	29	29	1.0	29	39			477
3	12800-02	2	12.8	-2.0	12.8	5.4	2.74	48.0	48.0	4Ab	29	29	1.0	29	49			205
4	12802-04	2	12.8	0.0	12.8	6.4	2.71	48.0	48.0	4Ab	29	29	1.0	29	38			394
5	12804-08	4	11.1	-5.4	11.1	2.9	2.80	47.5	47.5	5Ac	31	31	1.0	31	83			
6	12808-12	4	18.0	4.4	18.0	11.2	2.635	55.0	55.0	4Ad	6	6	1.0	6	48			1,157
7	12812-16	4	0.8	0.8	0.8	0.8	2.895	49.3	49.3	6Cf	8.1	8.1	1.0	8.1	589			
8	12816-19	3	15.8	6.0	15.8	10.9	2.605	56.0	56.0	3Cc	3.3	3.3	1.0	3.3	62			
9	12819-21	3	15.4	0.5	15.4	8.0	2.70	52.0	52.0	4Bc	3.3	3.3	1.0	3.3	92			
10	12821-22	1	19.7	0.5	19.7	10.1	2.70	52.0	52.0	5Ac	3.3	3.3	1.0	3.3	73			
11	12822-23	1	16.0	-2.0	16.0	7.0	2.74	50.9	50.9	5Bd	9	9	1.0	9	63			
12	12823-25	2	18.0	3.2	18.0	10.6	2.65	52.7	52.7	4Ac	9	9	1.0	9	42			
13	12825-28	3	1.0	0.0	1.0	0.5	2.705	48.4	48.4	2Cb	15	15	1.0	15	692			
14	12828-31	3	12.0	2.9	12.0	7.5	2.66	53.2	53.2	3Bc	7	7	1.0	7	67			
15	12831-33	2	0.4	0.0	0.4	0.2	2.72	47.3	47.3	2Bc	50	50	1.0	50	948			
16	12833-35	2	0.7	0.7	0.7	0.7	2.70	49.0	49.0	2Cb	50	50	1.0	50	271			
17	12835-37	2	1.0	0.0	1.0	0.5	2.715	48.5	48.5	2Cb	50	50	1.0	50	379			
18	12837-39	2	3.0	2.4	3.0	2.7	2.665	50.1	50.1	2Cb	20	20	1.0	20	111			
19	12839-41	2	1.7	0.0	1.7	0.9	2.705	49.8	49.8	2Cb	17	17	1.0	17	361			
20	12841-43	2	3.3	2.7	3.3	3.0	2.66	52.0	52.0	2Cc	5	5	1.0	5	199			
21	12843-44	1	3.3	2.0	3.3	2.7	2.67	52.0	52.0	2Dc	5	5	1.0	5	222			
22	12844-46	2	4.0	4.0	4.0	4.0	2.645	54.8	54.8	2Dd	3	3	1.0	3	193			
23	12846-49	3	11.8	2.2	11.8	7.0	2.67	53.1	53.1	3Cc	3	3	1.0	3	110			
24	12849-51	2	20.0	9.4	20.0	14.7	2.55	61.5	61.5	3De	1.7	1.7	1.0	1.7	69			
25	12851-52	1	18.6	8.2	18.6	13.4	2.565	58.9	58.9	3Cd	1.4	1.4	1.0	1.4	84			
26	12852-54	2	23.0	9.0	23.0	16.0	2.55	60.2	60.2	4Cc	1.4	1.4	1.0	1.4	70			
27	12854-58	4	14.0	3.2	14.0	8.6	2.65	52.8	52.8	3Bc	2	2	1.0	2	110			
28	12858-61	3	25.5	4.9	25.5	15.2	2.46	62.0	62.0	2Dc	0.42	0.42	1.0	0.42	136			
29	12861-64	3	22.0	11.0	22.0	16.5	2.52	51.8	51.8	4Cd	0.47	0.47	1.0	0.47	118			
30	12864-67	3	23.7	13.2	23.7	18.5	2.48	61.2	61.2	3Cc	0.50	0.50	1.0	0.5	102			
31	12867-71	4	16.7	6.0	16.7	11.4	2.60	54.6	54.6	3Bc	1.5	1.5	1.0	1.5	96			
32	12871-72	1	26.0	13.2	26.0	19.6	2.485	62.0	62.0	4Cd	0.57	0.57	1.0	0.57	90			
33	12872-74	2	21.3	11.7	21.3	16.5	2.51	61.1	61.1	3Cd	0.60	0.60	1.0	0.60	104			
34	12874-77	3	24.0	10.0	24.0	17.0	2.54	59.8	59.8	4Bd	0.70	0.70	1.0	0.70	94			
35	12877-79	2	16.0	7.1	16.0	11.6	2.59	55.0	55.0	3Bc	2.4	2.4	1.0	2.4	74			
36	12879-81	2	16.7	7.5	16.7	12.1	2.58	56.2	56.2	3Bc	2.4	2.4	1.0	2.4	71			
37	12881-85	4	3.0	-1.6	3.0	0.7	2.74	50.0	50.0	3Cc	10.2	10.2	1.0	10.2	600			
38	12885-92	7	6.0	0.0	6.0	3.0	2.70	50.6	50.6	2Cc	10.2	10.2	1.0	10.2	140			
39	12892-12900	8	2.9	-1.4	2.9	0.8	2.73	49.0	49.0	2Cc	30	30	1.0	30	306			
40	12900-03	3	6.0	-1.0	6.0	2.5	2.725	50.0	50.0	3Cc	10	10	1.0	10	169			
41	12903-12	9	2.0	-2.0	2.0	0.0	2.745	48.3	48.3	2Cc	57	57	1.0	57	17.8K			
42	12912-16	4	3.1	1.8	3.1	2.5	2.685	51.7	51.7	2Cc	50	50	1.0	50	75			
43	12916-19	3	2.0	-2.0	2.0	0.0	2.74	49.0	49.0	2Cc	90	90	1.0	90	14.1K			
44	12919-22	3	4.0	-1.0	4.0	1.5	2.72	50.0	50.0	2Cc	40	40	1.0	40	141			
45	12922-42	20	1.5	-1.0	1.5	0.3	2.725	48.4	48.4	2Cb	80	80	1.0	80	499			

Table E-49: Combined results of rock-typing and quantitative formation evaluation, T.M. Tribal #4-1, swse 4-158N-103W.

Zone#	Depth	H	ØN	ØD	ØNC	Xplot	Ø	Pb	Δt	Δtc	Code	Rt	CF	Rtc	Sw%	DST	Perf.	By-passed OIP(MBO)
1	11933-41	8	-1.0	-10+	0.0	0.0	2.995	50.5	50.0	6Df	9.0K	0.78	7.0K	1.6K				
2	11941-45	4	13.0	-2.1	14.0	6.0	2.75	49.0	48.5	5AC	18	0.78	14.0	59		Yes		
3	11945-46	1	9.9	-4.0	10.9	3.5	2.775	48.9	48.4	4Bc	18	0.78	14.0	102		Yes		
4	11946-48	2	12.0	-1.5	13.0	5.8	2.73	49.0	48.5	4Ab	14	0.78	10.9	70		Yes		
5	11948-51	3	11.4	-5.7	12.4	3.4	2.80	47.6	47.1	5AC	19	0.78	14.8	102		Yes		
6	11951-55	4	28.0	10.3	29.0	19.7	2.545	64.2	63.7	5Cf	2.7	0.78	2.1	46		Yes		
7	11955-58	3	11.2	-1.6	12.2	5.3	2.73	53.8	53.3	4Ce	5	0.78	3.9	128		Yes		
8	11958-61	3	22.0	5.8	23.0	14.4	2.62	55.7	55.2	5AC	4.8	0.78	3.7	48		Yes		
9	11961-64	3	7.0	-1.4	8.0	3.3	2.735	49.9	49.4	3Bc	20	0.78	15.6	102		Yes		
10	11964-68	4	25.7	8.4	26.7	17.6	2.57	59.6	59.1	4Bd	3	0.78	2.3	50		Yes		
11	11968-73	5	0.3	-2.6	1.3	0.0	2.75	50.0	49.5	3Cc	220	0.78	171.6	10-2K		Yes		
12	11973-75	2	2.5	0.0	3.5	1.8	2.715	52.1	51.6	2Dd	40	0.78	31.2	133				
13	11975-77	2	1.7	-2.5	2.7	0.1	2.75	49.7	49.2	3Cc	90	0.78	70.2	1.6K				
14	11977-80	3	0.3	0.0	1.3	0.7	2.705	48.9	48.4	2Bb	80	0.78	62.4	242				
15	11980-82	2	0.8	-2.4	1.8	0.0	2.75	49.4	48.9	3Cc	80	0.78	62.4	17.0K				
16	11982-84	2	1.7	2.0	2.7	2.4	2.68	51.0	50.5	2Cb	30	0.78	23.4	115				
17	11984-86	2	0.5	0.0	1.5	0.8	2.71	50.0	49.9	2Cb	73	0.78	56.9	222				
18	11986-92	6	1.0	1.0	2.0	1.5	2.695	51.5	51.0	2Dc	30	0.78	23.4	184				
19	11992-95	3	0.4	-0.3	1.4	0.6	2.75	50.3	49.8	2Cc	103	0.78	80.3	249				
20	11995-98	3	4.3	2.0	5.3	3.7	2.68	53.0	52.5	2Cc	12	0.78	9.4	118				
21	11998-12002	4	2.0	-4.0	3.0	0.0	2.775	50.0	49.5	3Cd	40	0.78	31.2	24.0K				
22	12002-04	2	7.0	0.0	8.0	4.0	2.71	52.1	51.6	3Cc	11	0.78	8.6	114				
23	12004-06	2	3.5	-3.1	4.5	0.7	2.76	51.0	50.5	3Dd	19	0.78	14.8	498				
24	12006-13	7	7.2	-0.6	8.2	3.8	2.72	52.1	51.6	3Cd	7.7	0.78	6.0	144				
25	12013-18	5	1.0	-4.0	2.0	0.0	2.775	48.8	48.3	3Cc	63	0.78	49.1	19.1K				
26	12018-21	3	1.4	0.0	2.4	1.2	2.70	51.8	51.3	2Dc	41	0.78	32.0	157				
27	12021-27	6	1.4	-2.0	2.4	0.2	2.74	50.0	49.5	2Cc	130	0.78	101.4	666				
28	12027-32	5	1.6	0.5	2.6	1.6	2.70	50.0	49.5	2Cb	40	0.78	31.2	150				
29	12032-34	2	2.1	-0.5	3.1	1.3	2.72	49.4	48.9	2Cb	25	0.78	19.5	233				
30	12034-36	2	1.0	-4.9	1.1	0.0	2.78	49.0	48.5	3Cc	60	0.78	46.8	19.6K				
31	12036-41	5	0.9	-2.0	1.9	0.0	2.75	49.3	48.8	3Cc	60	0.78	46.8	19.6K				
32	12041-45	4	0.4	-5.4	1.4	0.0	2.80	49.2	48.7	4Cd	250	0.78	195.0	9.6K				
33	12045-48	3	2.1	-0.5	3.1	1.3	2.72	53.0	52.5	2Dd	60	0.78	46.8	150				
34	12048-50	2	1.4	-3.1	2.4	0.0	2.76	49.4	48.9	3Cc	550	0.78	429.0	6.5K				
35	12050-54	4	2.3	0.1	3.3	1.7	2.70	54.4	53.9	2Dd	80	0.78	62.4	99				
36	12054-60	6	0.6	-3.0	1.6	0.0	2.76	49.5	49.0	3Cc	57	0.78	44.5	20.1K				
37	12060-63	3	0.5	0.4	1.5	1.0	2.70	50.6	50.1	2Cb	37	0.78	28.9	249				
38	12063-64	1	0.8	-2.6	1.8	0.0	2.75	50.6	50.1	3Dc	60	0.78	46.8	19.6K				
39	12064-66	2	0.5	-1.7	1.5	0.0	2.735	51.0	50.5	2Dc	49	0.78	38.2	21.7K				
40	12066-68	2	0.3	-4.0	1.3	0.0	2.775	50.9	50.4	3Dd	60	0.78	46.8	19.6K				
41	12068-74	6	0.5	-1.7	1.5	0.0	2.735	49.1	48.6	2Cb	55	0.78	42.9	20.5K				
42	12074-78	4	0.7	-5.2	1.7	0.0	2.80	49.0	48.5	4Cd	62	0.78	48.4	19.3K				
43	12078-82	4	1.0	-2.0	2.0	0.0	2.75	49.9	49.4	3Cc	50	0.78	39.0	716				
44	12082-85	3	0.5	-4.5	1.5	0.0	2.78	49.7	49.2	3Cd	90	0.78	70.2	16.0K				
45	12085-87	2	0.5	-2.2	1.5	0.0	2.75	49.2	48.7	3Cc	51	0.78	39.8	21.3K				
46	12087-88	1	0.5	-5.0	1.5	0.0	2.79	49.3	48.8	3Cd	73	0.78	56.9	17.8K				
47	12088-90	2	0.5	-3.4	1.5	0.0	2.76	49.3	48.8	3Cc	68	0.78	53.0	18.4K				
48	12090-93	3	0.7	-5.2	1.7	0.0	2.795	49.4	48.9	3Cd	100	0.78	78.0	15.2K				
49	12093-97	4	1.0	0.0	2.0	1.0	2.70	50.3	49.8	2Cb	39	0.78	30.4	243				
50	12097-12100	3	0.9	-4.0	1.9	0.0	2.775	49.5	49.0	3Cc	80	0.78	62.4	17.0K				

Table E-50: Combined results of rock-typing and quantitative formation evaluation, Arco #1 Maebec, sese 30-158N-103W.

Zone#	Depth	H	ϕ_N	ϕ_D	ϕ_{NC}	Xplot ϕ	Pb	Δt	Δt_c	Code	Rt	CF	Rtc	Sw ϕ	DST Perf.	By-passed OIP(MBO)
1	12342-51	9	-0.4	-10+	0.0	0.0	2.98	50.0	50.0	6Df	25K	0.38	9.8K	1.4K		
2	12351-54	3	9.8	-4.0	10.2	3.1	2.78	47.5	47.5	4Ac	55	0.38	55	94		
3	12354-61	7	7.0	-4.8	7.4	1.3	2.79	46.0	46.0	4Bd	75	0.38	28.5	193		
4	12361-68	7	26.0	10.0	26.4	18.2	2.55	59.0	59.0	5Bd	1.0	0.38	0.4	119		
5	12368-72	4	15.7	2.9	16.1	9.5	2.66	51.0	51.0	4Ab	4	0.38	1.5	115		
6	12372-76	4	22.2	5.0	22.6	13.8	2.625	54.0	54.0	5Ac	2.5	0.38	0.1	99		
7	12376-80	4	10.4	-2.9	10.8	4.0	2.75	49.0	49.0	4Bc	16	0.38	6.1	135		
8	12380-84	4	17.8	-0.1	18.2	9.1	2.71	51.5	51.5	5Ac	9	0.38	3.4	79		
9	12384-86	2	14.4	-2.0	14.8	6.4	2.74	50.0	50.0	5Ac	10	0.38	3.8	107		
10	12386-88	2	15.0	1.8	15.4	8.6	2.685	51.0	51.0	4Ac	7.5	0.38	2.9	91		
11	12388-92	4	14.0	0.8	14.4	7.6	2.70	52.0	52.0	4Bc	6	0.38	2.3	116		
12	12392-94	2	22.0	7.8	22.4	15.1	2.59	56.5	56.5	5Ac	2.7	0.38	1.0	88		
13	12394-96	2	21.9	4.8	22.3	13.6	2.635	56.0	56.0	5Bd	2.8	0.38	1.1	94		
14	12396-97	1	26.7	8.1	27.1	17.6	2.58	57.0	57.0	5Ac	2.2	0.38	1.0	76		
15	12397-12401	4	22.8	5.0	23.2	14.1	2.63	56.0	56.0	5Bd	2.4	0.38	1.0	95		
16	12401-04	3	24.0	8.0	24.4	16.2	2.58	57.5	57.5	5Bd	2.0	0.38	0.8	94		
17	12404-07	3	19.1	5.2	19.5	12.4	2.625	56.0	56.0	4Bd	4.0	0.38	1.5	88		
18	12407-10	3	19.8	7.8	20.2	14.0	2.585	55.0	55.0	4Ab	4.0	0.38	1.5	78		
19	12410-12	2	12.5	-0.3	12.9	6.3	2.72	50.0	50.0	4Ac	26	0.38	9.9	67		
20	12412-16	2	16.1	0.6	16.5	8.6	2.70	50.0	50.0	5Ab	10.2	0.38	3.9	78		
21	12416-18	2	10.9	-2.0	11.3	4.7	2.74	49.7	49.7	4Bc	11.5	0.38	4.4	136		
22	12418-21	3	13.0	-0.3	13.4	6.6	2.72	51.0	51.0	4Bc	8.7	0.38	3.3	111		
23	12421-24	3	10.0	-2.8	10.4	3.8	2.75	49.7	49.7	4Bc	12	0.38	4.6	164		
24	12424-30	6	17.0	0.7	17.4	9.1	2.70	50.2	50.2	5Ab	7	0.38	2.7	89		
25	12430-34	4	12.0	-1.3	12.4	5.6	2.73	51.5	51.5	4Bd	15	0.38	5.7	100		
26	12434-38	4	20.0	2.0	20.4	11.2	2.67	54.5	54.5	5Bd	5	0.38	1.9	86		
27	12438-41	3	16.5	0.6	16.9	8.8	2.70	52.5	52.5	5Bd	9	0.38	3.4	82		
28	12441-48	7	21.2	4.9	21.6	13.3	2.635	54.0	54.0	5Ac	4	0.38	1.5	82		
29	12448-52	4	19.0	2.0	19.4	10.7	2.68	52.0	52.0	5Ac	4.1	0.38	1.6	99		
30	12452-55	3	22.9	6.4	23.3	14.9	2.60	57.0	57.0	5Bd	2.3	0.38	1.0	90		
31	12455-57	2	17.5	3.5	17.9	10.7	2.65	54.8	54.8	4Bd	4.3	0.38	1.6	99		
32	12457-61	4	22.0	4.5	22.4	13.5	2.64	55.0	55.0	5Ad	5.0	0.38	1.9	72		
33	12461-63	2	9.0	-1.0	9.4	4.2	2.73	52.0	52.0	4Cd	20	0.38	7.6	115		
34	12463-65	2	19.0	3.5	19.4	11.5	2.65	54.0	54.0	5Ac	6.5	0.38	2.5	73		
35	12465-70	5	2.4	-0.4	2.8	1.2	2.71	50.0	50.0	2Cc	62	0.38	23.6	230		
36	12470-74	4	9.7	2.0	10.1	6.1	2.68	53.0	53.0	3Cc	5.7	0.38	2.2	148		
37	12474-76	2	1.5	-1.0	1.9	0.5	2.73	49.0	49.0	2Cc	40	0.38	15.2	688		
38	12476-79	3	4.0	-1.0	4.4	1.7	2.73	50.8	50.8	3Cc	18	0.38	6.8	302		
39	12479-82	3	3.5	-3.5	3.9	0.2	2.76	50.0	50.0	3Cd	30	0.38	11.4	2.0K		
40	12482-85	3	9.7	2.1	10.1	6.1	2.67	54.0	54.0	3Cd	5	0.38	1.9	159		
41	12485-87	2	13.0	1.0	13.4	7.2	2.695	55.0	55.0	4Ce	5	0.38	1.9	135		
42	12487-89	2	18.5	3.0	18.9	11.0	2.66	56.0	56.0	5Ce	2.9	0.38	1.1	116		
43	12489-91	2	16.0	2.1	16.4	9.3	2.675	55.5	55.5	4Ce	3.1	0.38	1.2	131		
44	12491-93	2	18.1	4.4	18.5	11.5	2.64	57.5	57.5	4Ce	2.3	0.38	1.0	116		
45	12493-95	2	14.6	2.3	15.0	8.7	2.67	55.0	55.0	4Cd	4.5	0.38	1.7	118		
46	12495-97	2	21.7	6.0	22.1	14.1	2.61	56.0	56.0	5Bd	2.8	0.38	1.1	90		
47	12497-12502	5	13.0	2.5	13.4	8.0	2.67	55.8	55.8	4De	3.7	0.38	1.4	141		
48	12502-07	5	7.6	-1.7	8.0	3.2	2.735	53.0	53.0	3De	11	0.38	4.2	204		
49	12507-13	6	16.3	2.5	16.7	9.6	2.67	55.2	55.2	4Cd	3.2	0.38	1.0	139		

Table E-51: Combined results of rock-typing and quantitative formation evaluation, Fischer #34-18, swse 18-159N-102W.

Zone#	Depth	H	ϕ_N	ϕ_D	ϕ_{Nc}	Xplot	ϕ	Pb	Δt	Δt_c	Code	Rt	CP	Rtc	Swt	DST	Perf.	By-passed OIP(MBO)
1	11968-76	8	-0.9	-10+	0.0	0.0	0.0	2.95	50.4	50.0	6Df	42K	0.59	24.8K	851			
2	11976-78	2	1.6	-6.2	2.5	0.0	0.0	2.81	48.7	48.3	4Cd	230	0.59	135.7	11.5K			
3	11978-82	4	2.0	-8.0	2.9	0.0	0.0	2.84	45.0	44.6	4Ac	350	0.59	206.5	9.3K			
4	11982-85	3	8.8	-2.7	9.7	3.5	3.5	2.75	49.5	49.1	4Bc	41	0.59	24.2	77			
5	11985-88	3	6.0	-5.7	6.9	0.6	0.6	2.80	47.1	46.7	4Bc	92	0.59	54.3	303			
6	11988-92	2	6.5	-3.2	7.4	2.1	2.1	2.76	49.0	48.6	3Bc	39	0.59	23.0	133			
7	11992-95	3	10.9	0.8	11.8	6.3	6.3	2.70	52.3	51.9	4Bc	20	0.59	11.8	61			
8	11995-99	4	2.9	-6.1	2.8	0.0	0.0	2.81	47.0	46.6	4Bc	170	0.59	100.3	13.4K			
9	11999-12003	4	7.0	-4.8	7.9	1.2	1.2	2.78	48.0	47.6	4Bc	28	0.59	16.5	275			
10	12003-06	3	3.9	-6.9	4.8	0.0	0.0	2.82	46.0	45.6	4Ac	100	0.59	59.0	17.5K			
11	12006-09	3	7.0	-3.4	7.9	2.3	2.3	2.77	48.5	48.1	4Bc	21	0.59	12.4	165			
12	12009-12	3	5.1	-5.5	6.0	0.3	0.3	2.805	46.6	46.2	4Bc	52	0.59	30.7	807			
13	12012-14	2	6.0	-4.0	6.9	1.5	1.5	2.73	48.0	47.6	3Bb	52	0.59	30.7	161			
14	12014-16	2	3.5	-5.4	4.4	0.0	0.0	2.80	46.9	46.5	4Bc	120	0.59	70.8	15.9K			
15	12016-18	2	5.5	-2.5	6.4	2.0	2.0	2.75	49.0	48.6	3Bc	32	0.59	18.9	154			
16	12018-20	2	3.8	-4.2	4.7	0.3	0.3	2.78	48.2	47.8	3Bc	70	0.59	41.3	695			
17	12020-27	7	8.4	-2.6	9.3	3.4	3.4	2.755	49.1	48.7	4Bc	30	0.59	17.7	93			
18	12027-29	2	6.0	-4.4	6.9	1.3	1.3	2.79	47.5	47.1	4Bc	54	0.59	31.9	182			
19	12029-32	3	11.2	1.7	12.1	6.9	6.9	2.665	50.9	50.5	4Ab	25	0.59	14.8	50			
20	12032-36	4	3.2	-5.0	4.1	0.0	0.0	2.80	47.2	46.8	4Bc	200	0.59	118.0	12.4K			
21	12036-39	3	5.1	-2.5	6.0	1.8	1.8	2.75	48.1	47.7	3Bb	50	0.59	29.5	137			
22	12039-42	3	2.9	-6.0	2.8	0.0	0.0	2.81	47.5	47.3	4Bc	170	0.59	100.3	13.4K			
23	12042-44	2	8.0	-0.9	8.9	4.0	4.0	2.75	48.0	47.6	4Bc	22	0.59	17.7	79	Yes		
24	12044-47	3	7.5	-2.9	8.4	2.3	2.3	2.775	48.5	48.1	3Ab	30	0.59	13.0	161	Yes		
25	12047-51	4	6.8	-2.5	7.7	2.6	2.6	2.75	47.0	46.6	3Ad	30	0.59	17.7	122	Yes		
26	12051-54	3	8.6	-0.2	9.5	4.7	4.7	2.715	50.0	49.6	3Bc	22	0.59	13.0	79	Yes		
27	12054-55	1	6.5	-4.0	7.4	1.7	1.7	2.78	48.4	48.0	4Bc	80	0.59	47.2	114	Yes		
28	12055-57	2	7.2	-2.5	8.1	2.8	2.8	2.75	49.3	48.9	3Bc	70	0.59	41.3	74	Yes		
29	12057-59	2	5.5	-4.0	6.4	1.2	1.2	2.775	48.6	48.2	3Bc	150	0.59	88.5	118	Yes		
30	12059-64	5	5.9	-2.5	6.8	2.2	2.2	2.75	48.9	48.5	3Bc	120	0.59	70.8	72	Yes		
31	12064-66	2	7.0	-1.0	7.9	3.5	3.5	2.725	48.4	48.0	3Ab	27	0.59	15.9	96	Yes		
32	12066-68	2	6.0	-6.1	6.9	0.4	0.4	2.81	47.8	47.4	4Bc	29	0.59	17.1	1.0K	Yes		
33	12068-72	4	8.0	-3.9	8.9	2.5	2.5	2.77	48.1	47.7	4Bc	27	0.59	15.9	134	Yes		
34	12072-75	3	7.0	-5.6	7.9	1.2	1.2	2.805	47.9	47.5	4Bc	90	0.59	53.1	153	Yes		
35	12075-77	2	8.0	-4.0	8.9	2.5	2.5	2.78	48.4	48.0	4Bc	69	0.59	40.7	84	Yes		
36	12077-80	3	5.0	-3.7	5.9	1.1	1.1	2.765	48.2	47.8	3Bc	101	0.59	59.6	157	Yes		
37	12080-84	4	8.3	-3.2	9.2	3.0	3.0	2.755	50.1	49.7	4Bc	22	0.59	13.0	124	Yes		
38	12084-86	2	6.8	-4.7	7.7	1.5	1.5	2.79	48.0	47.6	4Bc	52	0.59	30.7	161	Yes		
39	12086-90	4	9.8	-3.0	10.7	3.9	3.9	2.75	48.9	48.5	4Ac	25	0.59	14.8	89	Yes		
40	12090-93	3	7.1	-6.0	8.0	1.0	1.0	2.805	47.7	47.3	4Bc	21	0.59	12.4	381	Yes		
41	12093-96	3	14.0	-3.5	14.9	5.7	5.7	2.77	51.9	51.5	5Bc	20	0.59	11.8	68	Yes		
42	12096-98	2	6.7	-4.0	7.6	1.8	1.8	2.775	47.5	47.1	4Ac	25	0.59	14.8	193	Yes		
43	12098-12101	3	8.1	-3.0	9.0	3.0	3.0	2.75	48.4	48.0	4Ab	16	0.59	9.4	145	Yes		
44	12101-04	3	5.6	-7.1	6.5	0.0	0.0	2.83	47.9	47.5	4Bd	17	0.59	10.0	42.4K	Yes		
45	12104-07	3	10.0	-3.0	10.9	4.0	4.0	2.75	49.1	48.7	4Ac	14	0.59	8.3	116	Yes		
46	12107-09	2	7.9	-5.2	8.8	1.8	1.8	2.80	47.9	47.5	4Bc	20	0.59	11.8	216	Yes		
47	12109-12	3	10.0	-4.5	10.9	3.2	3.2	2.78	47.5	47.1	4Ac	21	0.59	11.8	122	Yes		
48	12112-15	3	8.0	-6.0	8.9	1.5	1.5	2.805	47.0	46.6	4Ac	21	0.59	12.4	254	Yes		
49	12115-18	3	13.0	-2.0	13.9	6.0	6.0	2.745	48.9	48.5	5Ac	16	0.59	9.4	72	Yes		
50	12118-20	2	6.3	-4.0	7.2	1.6	1.6	2.78	47.5	47.1	4Bc	15	0.59	8.9	281	Yes		
51	12120-26	6	10.9	-2.5	11.8	4.7	4.7	2.75	49.5	49.1	4Ac	11	0.59	6.5	111	Yes		
52	12126-28	2	8.2	-5.5	9.1	1.8	1.8	2.80	48.3	47.9	4Bc	15	0.59	8.9	249	Yes		
53	12128-32	4	10.2	-1.8	11.1	4.7	4.7	2.735	50.0	49.6	4Bc	10	0.59	5.9	117	Yes		

Table E-52: Combined results of rock-typing and quantitative formation evaluation, Gerald Fischer #1, zone 31-160M-102W.

Zone#	Depth	H	ΔN	ΔD	ΔMC	ΔPlot	ΔP	Δt	Δtc	Code	Rt	CP	Rtc	SWA	DST	Perf.	By-passed OIP(MBO)
1	11710-20	10	-1.0	-10+	0.0	0.0	2.97	50.0	50.0	60f	8K	1.0	8K	1.53	Yes		
2	11720-23	3	3.5	-6.1	4.5	0.0	2.81	45.9	45.9	4Ac	170	1.0	170	10.3K	Yes		
3	11723-25	2	3.5	-10+	4.5	0.0	2.93	47.9	47.9	68f	170	1.0	170	10.3K	Yes		
4	11725-26	1	9.4	-0.7	10.4	4.9	2.725	57.0	57.0	40f	30	1.0	30	97	Yes	124	
5	11726-28	1	5.0	-1.1	6.0	2.5	2.725	57.0	57.0	30f	30	1.0	30	97	Yes		
6	11728-31	3	27.9	12.5	28.9	20.7	2.505	63.1	63.1	5Cb	0.95	1.0	0.95	66	Yes		
7	11731-33	2	25.1	12.3	26.1	19.2	2.505	60.5	60.5	48c	1.2	1.0	1.2	66	Yes		
8	11733-36	3	33.0	19.0	34.0	26.5	2.405	66.0	66.0	58a	1.0	1.0	1.0	50	Yes	1,974	
9	11736-39	3	15.9	-1.2	16.9	7.9	2.73	50.0	50.0	5Ac	10.2	1.0	10.2	53	Yes		
10	11739-44	5	17.1	2.1	18.1	10.1	2.68	51.4	51.4	5Ac	7	1.0	7	50	Yes	1,254	
11	11744-47	3	9.8	-7.2	10.8	1.8	2.82	48.3	48.3	58d	29	1.0	29	138	Yes		
12	11747-52	5	10.0	-3.0	11.0	4.0	2.76	49.0	49.0	48c	26	1.0	26	65	Yes		
13	11752-55	2	3.6	-10+	4.6	0.0	2.90	46.5	46.5	68a	100	1.0	100	13.4K	Yes		
14	11755-56	1	8.0	-2.0	9.0	3.5	2.73	48.0	48.0	38b	60	1.0	60	59	Yes	1,329	
15	11758-58	2	8.0	-4.0	9.0	2.5	2.77	47.8	47.8	48c	60	1.0	60	69	Yes		
16	11758-60	2	8.5	-2.3	9.5	3.6	2.75	48.4	48.4	48c	13	1.0	13	103	Yes		
17	11760-62	2	13.0	0.0	14.0	7.0	2.71	52.4	52.4	48d	13	1.0	13	53	Yes		
18	11762-65	3	21.1	3.8	22.1	13.0	2.65	53.4	53.4	58d	3	1.0	3	59	Yes		
19	11765-70	5	1.0	-0.6	2.0	0.7	2.72	49.0	49.0	2Cb	120	1.0	120	174	Yes		
20	11770-72	2	1.0	1.1	2.0	1.6	2.69	50.1	50.1	2Cb	46	1.0	46	123	Yes		
21	11772-73	1	1.0	-0.0	2.0	0.5	2.73	50.0	50.0	2Cc	51	1.0	51	375	Yes		
22	11773-75	2	3.5	0.5	4.5	2.5	2.70	50.7	50.7	2Cc	25	1.0	25	107	Yes		
23	11775-78	3	2.9	-1.8	3.9	1.1	2.74	50.0	50.0	3Cc	45	1.0	45	181	Yes		
24	11778-82	4	19.5	8.2	20.5	14.4	2.575	58.2	58.2	4C	1.4	1.0	1.4	78	Yes		
25	11782-84	2	21.7	6.5	22.7	14.6	2.61	57.1	57.1	58d	1.2	1.0	1.2	83	Yes		
26	11784-86	2	26.5	9.1	27.5	18.3	2.56	60.1	60.1	58a	1	1.0	1	73	Yes		
27	11788-88	2	18.0	2.5	17.0	9.8	2.67	53.2	53.2	48c	5.1	1.0	5.1	60	Yes	1,978	
28	11788-92	4	28.2	4.0	29.2	16.6	2.65	54.0	54.0	6Ac	4	1.0	4	40	Yes		
29	11792-95	3	22.0	7.1	23.0	15.1	2.595	56.0	56.0	5Ac	1.8	1.0	1.8	66	Yes		
30	11795-97	2	21.0	3.9	22.0	13.0	2.65	55.7	55.7	58d	2	1.0	2	72	Yes		
31	11797-98	1	23.3	6.0	24.3	15.2	2.62	55.7	55.7	58d	2	1.0	2	62	Yes		
32	11798-11802	4	20.0	4.0	21.0	12.5	2.65	54.9	54.9	58d	2.1	1.0	2.1	74	Yes		
33	11802-05	3	22.4	4.9	23.4	14.2	2.63	55.7	55.7	58d	2	1.0	2	66	Yes		
34	11805-07	2	12.9	0.1	13.9	7.0	2.71	52.0	52.0	48d	20	1.0	20	42	Yes	403	
35	11807-10	3	17.2	4.1	18.2	11.2	2.64	55.4	55.4	48d	5.4	1.0	5.4	51	Yes		
36	11810-14	4	11.0	2.0	12.0	7.0	2.67	53.5	53.5	3Cc	10	1.0	10	60	Yes		
37	11814-16	2	12.0	-0.3	13.0	6.0	2.715	51.8	51.8	48d	7	1.0	7	79	Yes		
38	11816-18	2	19.0	5.5	20.0	12.8	2.62	53.3	53.3	48b	2.4	1.0	2.4	67	Yes		
39	11818-20	2	18.3	3.9	19.3	11.6	2.65	53.3	53.3	5Ac	2.4	1.0	2.4	74	Yes		
40	11820-25	5	23.0	7.3	24.0	15.7	2.59	58.0	58.0	58a	0.5	1.0	0.5	321	Yes	634	
41	11825-30	5	12.0	-1.3	13.0	15.9	2.75	49.5	49.5	5Ac	6.5	1.0	6.5	45	Yes		
42	11830-32	2	18.0	4.1	19.0	11.6	2.685	53.2	53.2	48c	7.1	1.0	7.1	55	Yes		
43	11833-38	5	22.0	5.0	23.0	19.0	2.70	53.2	53.2	58d	1.8	1.0	1.8	71	Yes		
44	11833-38	5	22.0	5.0	23.0	19.0	2.70	53.2	53.2	58d	1.8	1.0	1.8	71	Yes		
45	11838-41	3	16.5	-1.1	17.5	8.2	2.73	52.3	52.3	58a	10.5	1.0	10.5	50	Yes	611	
46	11841-44	3	15.8	2.9	16.8	9.3	2.66	56.0	56.0	4Cc	3	1.0	3	78	Yes		
47	11844-48	4	2.2	-2.7	3.2	0.3	2.755	50.0	50.0	3Cc	14	1.0	14	1.2K	Yes		
48	11848-51	3	6.0	0.0	7.0	3.5	2.705	54.0	54.0	3De	7	1.0	7	144	Yes		
49	11851-53	2	4.4	-2.1	5.4	1.7	2.75	51.4	51.4	3De	10	1.0	10	249	Yes		
50	11853-56	3	14.2	2.8	15.2	9.0	2.66	58.5	58.5	4Df	2.4	1.0	2.4	96	Yes		
51	11856-61	5	22.0	7.7	23.0	15.4	2.59	60.8	60.8	5Df	1.3	1.0	1.3	76	Yes		
52	11861-63	2	20.1	5.3	21.1	13.2	2.625	59.0	59.0	5Cf	1.5	1.0	1.5	87	Yes		
53	11863-65	2	23.2	8.0	24.2	16.1	2.585	60.0	60.0	5Cc	1.4	1.0	1.4	70	Yes		
54	11865-68	3	9.0	-1.0	10.0	4.5	2.73	52.5	52.5	4Cd	4.5	1.0	4.5	140	Yes		
55	11868-70	2	21.0	5.0	22.0	13.5	2.63	58.4	58.4	5Cc	1.9	1.0	1.9	72	Yes		
56	11870-72	2	12.2	-0.7	13.3	6.3	2.72	55.2	55.2	4Df	4.2	1.0	4.2	103	Yes		
57	11872-74	2	13.8	2.0	14.8	8.4	2.68	56.0	56.0	4De	4	1.0	4	79	Yes		
58	11874-76	2	8.5	-0.8	9.5	4.4	2.72	54.0	54.0	3De	7	1.0	7	115	Yes		
59	11876-78	2	6.0	1.2	7.0	4.1	2.69	52.8	52.8	3Cd	8	1.0	8	115	Yes		
60	11878-81	3	7.0	-1.5	8.0	3.3	2.735	53.8	53.8	3De	8	1.0	8	103	Yes		
61	11881-83	2	14.0	4.6	15.0	9.8	2.64	57.7	57.7	4De	2	1.0	2	96	Yes		
62	11883-85	2	10.6	0.5	11.6	6.1	2.70	56.0	56.0	4Df	2.8	1.0	2.8	131	Yes		
63	11885-86	1	12.5	1.2	13.5	7.4	2.69	56.5	56.5	4Df	2.2	1.0	2.2	121	Yes		
64	11886-88	2	3.8	-3.2	4.8	0.8	2.76	49.7	49.7	3Cc	10	1.0	10	530	Yes		
65	11888-89	1	5.4	0.1	6.4	3.3	2.70	52.8	52.8	3Dd	7	1.0	7	153	Yes		
66	11889-92	3	2.9	-1.5	3.9	1.2	2.735	51.0	51.0	3Dd	10.5	1.0	10.5	345	Yes		
67	11892-94	2	4.2	0.8	5.2	3.0	2.70	52.0	52.0	2Cc	23	1.0	23	28.0K	Yes		
68	11894-97	3	1.8	-3.1	2.8	0.0	2.76	51.0	51.0	3Dd	20	1.0	20	199	Yes		
69	11897-99	2	2.0	0.0	3.0	1.5	2.71	50.9	50.9	2Cc	29	1.0	29	830	Yes		
70	11899-11902	3	1.7	-2.2	2.7	0.3	2.75	50.7	50.7	3Dd	23	1.0	23	139	Yes		
71	11902-05	3	2.3	0.6	3.3	2.0	2.70	50.2	50.2	2Cb	23	1.0	23		Yes		

R 55 E

R 56 E

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48.7 N
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R 57 E

R 58 E

R 103 W

R 102 W

102 W

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33
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R 56 E

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R 59 E

R 103 W

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