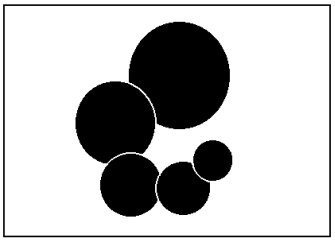

MICROPALEO CONSULTANTS, INC.

EXXONMOBIL (EXXON)

ANTARES NO. 1 (OCS-Y-0280)

API #55-232-00001

BEAUFORT SEA, ALASKA

Prepared by:

Michael B. Mickey - Foraminifera

Hideyo Haga - Palynomorphs

BIOSTRATIGRAPHY REPORT

M.C.I. Job No. 99-111 **November, 2000**

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7460-7812'

Late Triassic
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Discussion. Sag River Sandstone equivalent within this interval.

7812-8045'

Late Triassic
Norian
TL_{N}

Discussion. Shublik Fm.

8045-8155'

Late Triassic
Possible Carnian
$TL_{C?}$

Discussion. Basal pebble sandstone.

8155-8387'

Early Triassic
Undifferentiated
TE

Discussion. Sadlerochit Group. Ivishak Fm.

8387-8450'T.D.

Indeterminate Age

Discussion. Dark gray to black argillite.

FORAMINIFERA REPORT

Interpreted by:

Michael B. Mickey

FORAMINIFERA SUMMARY

260-350'

Age.	Tertiary to Quaternary Probable Pliocene
Zones.	Probable F-2A(1) to F-2A(2)
Environment.	Inner Neritic (Inner Shelf)

350-710'?

Age.	Tertiary Early to Middle Miocene
Zones.	F-2B(1) to F-2B(2a)
Environment.	Inner to Middle Neritic (Inner to Middle Shelf)

710?-1310'?

Age.	Tertiary Undifferentiated
Environment.	Nonmarine to Marginal Marine (Alluvial Plain to Transitional)

1310?-1820'

Age.	Late Cretaceous Campanian to Maestrichtian
Zones.	F-5 to F-6
Environment.	Middle Neritic to Upper Bathyal (Middle Shelf to Upper Slope)

1820-2840'

Age.	Late Cretaceous Turonian to Santonian
Zones.	F-6 to F-7
Environment.	Probable Middle to Lower Bathyal (Probable Middle to Lower Slope)

2840-3110'

Age.	Late Cretaceous Cenomanian? to Turonian
Zones.	F-7 to F-8?
Environment.	Lower Bathyal - Distal (Base of Slope - Starved Basin)

3110-7070'?

Age.	Early Cretaceous Middle to Late Albian
Zone.	F-10
Environment.	Outer Neritic to Upper Bathyal (Outer Shelf to Upper Slope)

7070?-7190'

Age.	Early Cretaceous Aptian? to Early Albian
Zone.	F-11
Environment.	Middle to Lower Bathyal - Distal (Middle to Lower Slope - Starved Basin)

7190-7340'C

Age.	Early Cretaceous Barremian
Zone.	F-12
Environment.	Upper to Lower Bathyal - Distal (Upper to Lower Slope - Starved Basin)

7340C-7460'

Age.	Early Cretaceous Hauterivian
Zone.	F-13a
Environment.	Middle Neritic to Upper Bathyal (Middle Shelf to Upper Slope)

7460-7815'C

Age.	Late Triassic Probable Rhaetian
Zone.	Probable F-19a
Environment.	Middle Neritic (Middle Shelf)
Discussion.	Probable Sag River Sandstone equivalent at 7550 to 7640 feet.

7815C-8055'C

Age.	Late Triassic Norian
Zone.	F-19b
Environment.	Inner to Middle Neritic (Inner to Middle Shelf)
Discussion.	Shublik Fm.

8055C-8174'C

Age.	Late Triassic Possible Carnian
Zone.	F-19c?
Environment.	Marginal Marine to Inner Neritic (Transitional to Inner Shelf)
Discussion.	Basal pebble sandstone.

8174C-8390'

Age.	Early Triassic Undifferentiated
Zone.	F-20a
Environment.	Nonmarine to Marginal Marine (Alluvial Plain to Transitional)
Discussion.	Sadlerochit Group. Ivishak Fm.

8390-8450'T.D.

Age.	Indeterminate
Environment.	Indeterminate
Discussion.	Dark gray to black argillite.

INTRODUCTION

Scope

Micropaleo Consultants, Inc. processed, picked and analyzed for Foraminifera 175 ditch samples and 19 conventional core samples from the ExxonMobil (Exxon) Antares No. 1 (OCS-Y-0280) well. These samples covered the interval 260 to 8450 feet total depth. This report was done as part of M.C.I. Job No. 99-111.

Procedures

Standard techniques were used to process the material. All samples were boiled in Quaternary-O and washed over 20 and 200 mesh screens. Frequency symbols correspond to the following numerical values: very rare (1), rare (2 - 4), frequent (5 -25), common (26 - 100), abundant (101 - 999) and prolific (1000+). The picked foram slides and residues are reposited at the State of Alaska Geological Materials Center in Eagle River, Alaska.

Certain factors such as shelf widths, basin configuration and overall basin depths associated with Arctic Mesozoic basins are not completely understood at present. The paleoenvironments presented in this report reflect relative basinal position only and should not be tied to specific water depths. Generally, neritic corresponds to shelf or deltaic environments, while bathyal corresponds to slope or prodelta environments and bathyal (starved basin) corresponds to distal (far from the source) deposition. As an example, prodelta deposits could represent deposition as shallow as middle neritic or as deep as bathyal (slope) depending on the delta type and shelf width. With a narrow shelf, a river-dominated deltaic system could build across the shelf and the prodelta deposits would be in a bathyal (slope) depth. A tide-dominated deltaic system associated with a wide shelf could result in middle neritic prodelta deposition.

Format

A listing of the age, environment, fauna and occasional lithology comments for each biostratigraphic interval follows. A generalized summary of the well is presented in the Conclusions section at the end of the Foraminifera Report. A Foraminifera Distribution Chart (Figure F-1) and a High Resolution Biostratigraphy Plot (Figure B-1) containing foram diversity/abundance plots, a cumulative faunal plot and a graphic paleoenvironmental display are in pockets at the back of this report.

RESULTS

260-350'

Age. Tertiary to Quaternary
Probable Pliocene

Zones. Probable F-2A(1) to F-2A(2)

Environment. Inner Neritic
(Inner Shelf)

Fauna. *Cibicides grossa, Elphidium ustulatum, E. clavatum, E. frigidum, Elphidiella brunnescens, Buccella frigida, Lenticulina nikobarensis, Nonion erucopsis, Cassidulina minuta, C. subglobosa*, shell fragments, echinoid spines, and frequent glauconite at the base of the interval.

350-710'?

Age. Tertiary
Early to Middle Miocene

Zones. F-2B(1) to F-2B(2a)

Environment. Inner to Middle Neritic
(Inner to Middle Shelf)

Fauna. *Elphidiella brunnescens, Cibicides perlucidus, Elphidium clavatum, E. ustulatum, Pyrgo depressa, P. lucernula, Quinqueloculina seminulum, Q. akneriana, Angulogerina fluens, A. angulosa, Nonion erucopsis, N. labradoricum, Globulina inaequalis, Asterigerina guerichi, Fissurina globosa, Globobulimina auriculata, Turrilina alsatica*, shell fragments, ostracods, pelmatozoan fragments, calcispheres, plant debris, pyrite, pyrite sticks, and frequent to common glauconite at the top of the interval.

710?-1310'?

Age.	Tertiary Undifferentiated
Environment.	Nonmarine to Marginal Marine (Alluvial Plain to Transitional)
Fauna.	Essentially barren of indigenous Foraminifera. Plant debris, pyrite and coal.

1310?-1820'

Age.	Late Cretaceous Campanian to Maestrichtian
Zones.	F-5 to F-6
Environment.	Middle Neritic to Upper Bathyal (Middle Shelf to Upper Slope)
Fauna.	*Alveolophragmium amplectens, Anomalinoides pinguis, A. talaria, Arenobulimina torula, Eoeponidella strombodes, Haplophragmoides rota, H. excavatus, H. bonanzaensis, Trochammina ribstonensis, T. albertensis, Verneuilinoides fischeri, Neobulimina albertensis, N. canadensis, Gavelinella tumida, Praebulimina venusae*, pyrite, common to abundant radiolaria below 1460 feet, and frequent volcanic glass shards between 1460 and 1550 feet.

1820-2840'

Age.	Late Cretaceous Turonian to Santonian
Zones.	F-6 to F-7
Environment.	Probable Middle to Lower Bathyal (Probable Middle to Lower Slope)
Fauna.	Mostly barren of Foraminifera with rare scattered occurrences of *Bathysiphon varans, Haplophragmoides excavatus, H. bonanzaensis, H. rota, Verneuilinoides fischeri, Elphidium ustulatum, Saccammina lathrami*, fish debris and rare to common radiolaria.

2840-3110'

Age.	Late Cretaceous Cenomanian? to Turonian
Zones.	F-7 to F-8?
Environment.	Lower Bathyal - Distal (Base of Slope - Starved Basin)
Fauna.	Mostly barren of indigenous Foraminifera. Fish debris, pyrite, bentonitic? paper shale and rare to common radiolaria.

3110-7070'?

Age.	Early Cretaceous Middle to Late Albian
Zone.	F-10
Environment.	Outer Neritic to Upper Bathyal (Outer Shelf to Upper Slope)
Fauna.	*Lenticulina macrodisca, L. muensteri, Haplophragmoides excavatus, H. topagorukensis, H. gigas, H. kirki, H. linki, Trochammina rainwateri, T. mcmurrayensis, Verneuilinoides borealis, Bathysiphon vitta, Conorboides umiatensis, Ammobaculites fragmentarius, A. wenonahae, Miliammina manitobensis, Oolina apiculata, Globulina prisca, Valvulineria loetterlei, Textularia topagorukensis, Saracenaria projectura, Miliammina ischia, Gavelinella awunensis, Psamminopelta bowsheri*, megaspores, *Ditrupa cornu*, pelmatozoan fragments, fish debris, *Inoceramus* prisms, pyrite, coal and tar.

7070?-7190'

Age.	Early Cretaceous Aptian? to Early Albian
Zone.	F-11
Environment.	Middle to Lower Bathyal - Distal (Middle to Lower Slope - Starved Basin)
Fauna.	Essentially barren of indigenous Foraminifera. Common paper shale in lower half of the interval.

7190-7340'C

Age. Early Cretaceous
Barremian

Zone. F-12

Environment. Upper to Lower Bathyal - Distal
(Upper to Lower Slope - Starved Basin)

Fauna. *Haplophragmoides duoflatis, H. coronis*, arenaceous spp., a. spp. (large, coarse), *Bathysiphon scintillata, Trochamminoides* sp. (small, thin), *Ammodiscus* sp. (small, thin), rare to frequent pyritized radiolaria above 7310 feet, frequent to common paper shale and rare to common rounded frosted quartz floating sand grains.

7340C-7460'

Age. Early Cretaceous
Hauterivian

Zone. F-13a

Environment. Middle Neritic to Upper Bathyal
(Middle Shelf to Upper Slope)

Fauna. *Praebulimina* sp. 2, *Oolina apiculata, Conorboides umiatensis, Marginulinopsis collonsi, Gravellina* sp. 1, *Ammobaculites reophacoides, A. erectus, Gaudryina tailleuri, Bathysiphon scintillata*, arenaceous spp. (large, coarse), *Haplophragmoides coronis, H. duoflatis, Lenticulina muensteri, Trochammina conicominuta, Glomospirella arctica, Gaudryinella irregularis, Lituotuba gallupi* and frequent to common rounded frosted quartz floating sand grains.

7460-7815'C

Age. Late Triassic
Probable Rhaetian

Zone. Probable F-19a

Environment. Middle Neritic
(Middle Shelf)

Fauna. *Nodosaria larina, N. radiata, Frondicularia acmaea, Astacolus connudatus, Lingulina alaskensis, Ammobaculites* sp. (small, bell-shaped), *A. sthenarus, Trochammina* sp. (small), *Vaginulinopsis acrulus*, frequent *Monotis/Halobia* shell fragments in the core from 7755 to 7815 feet, and rare pale green glauconite in the core from 7519 to 7579 feet.

Discussion. Probable Sag River Sandstone equivalent at 7550 to 7640 feet.

7815C-8055'C

Age. Late Triassic
Norian

Zone. F-19b

Environment. Inner to Middle Neritic
(Inner to Middle Shelf)

Fauna. *Nodosaria shublikensis, Astacolus connudatus, Pseudoglandulina* sp., *P. simpsonensis*, echinoid spines, medium to large size smooth ostracods, rare to frequent *Monotis/Halobia* shell fragments, frequent pale green glauconite in the core from 7875 to 7935 feet, and common dark gray to black sand-size phosphate? pebbles in the core from 7995 to 8055 feet.

Discussion. Shublik Fm.

8055C-8174'C

Age.	Late Triassic Possible Carnian
Zone.	F-19c?
Environment.	Marginal Marine to Inner Neritic (Transitional to Inner Shelf)
Fauna.	*Trochammina* sp. (small), *Bolivina lathetica, Discorbis pristina, Nodosaria larina, N. shublikensis, Ammodiscus gurgitata*, pelecypods (pyrite casts) and frequent dark gray to black sand-size phosphate pebbles.
Discussion.	Basal pebble sandstone.

8174C-8390'

Age.	Early Triassic Undifferentiated
Zone.	F-20a
Environment.	Nonmarine to Marginal Marine (Alluvial Plain to Transitional)
Fauna.	Essentially barren of indigenous Foraminifera. Frequent siderite in the core from 8174 to 8233 feet, and rare scattered pyrite.
Discussion.	Sadlerochit Group. Ivishak Fm.

8390-8450'T.D.

Age.	Indeterminate
Environment.	Indeterminate
Fauna.	Barren of indigenous Foraminifera.
Discussion.	Dark gray to black argillite.

CONCLUSIONS

The ExxonMobil (Exxon) Antares No. 1 (OCS-Y-0280) well penetrated the following biostratigraphic sequence based on foraminiferal analysis:

- 450+ feet (260-710'?) of Tertiary to Quaternary Early Miocene to probable Pliocene age (Late Brookian) inner to middle shelf clastic deposition.

- 600 feet (710?-1310'?) of undifferentiated Tertiary age (probable Middle Brookian) alluvial plain to transitional clastics.

- 1530 feet (1310?-2840') of Turonian to Maestrichtian age (Early Brookian) upward shallowing slope foresets to middle and outer shelf topsets.

- 4620 feet (2840-7460') of Hauterivian to probable Cenomanian age (Early Brookian & Beaufortian - Rift Sequence) middle to outer shelf topsets, slope foresets and base of slope bottomsets.

- 930 feet (7460-8390') of Early Triassic to Late Triassic (probable Rhaetian) age (Late Ellesmerian) nonmarine to middle shelf deposition.

- 60+ feet (8390-8450'T.D.) of indeterminate age (Franklinian) dark gray to black argillite basement rocks.

PALYNOLOGY REPORT

Interpreted by:

Hideyo Haga

PALYNOLOGY SUMMARY

260-350'

Age.	Tertiary - Quaternary Pliocene - Pleistocene
Environment.	Nonmarine

350-1190'

Age.	Tertiary Undifferentiated
Environment.	Marginal Marine - Nonmarine
Remarks.	Possibly in Miocene at 350 feet. May be as old as Eocene by 700 feet.

1190-1400'

Age.	Late Cretaceous Maestrichtian
Zone.	P-T11 and marginal marine equivalent
Environment.	Nonmarine - Marginal Marine

1400-1460'

Age.	Late Cretaceous Probable Campanian
Zone.	Probable P-T12 and marginal marine equivalent
Environment.	Marginal Marine

1460-2030'

Age.	Late Cretaceous Probable Santonian - Campanian
Zone.	Probable P-M14
Environment.	Marine

2030-2870'

Age.	Late Cretaceous Turonian - Coniacian
Zone.	P-M15
Environment.	Marine

2870-7160'

Age.	Early Cretaceous Middle - Late Albian
Zone.	P-M17
Environment.	Marine

7160-7340'C

Age.	Early Cretaceous Barremian - Early Albian
Zone.	P-M18a
Environment.	Marine

7340C-7460'C

Age.	Early Cretaceous Hauterivian
Zone.	P-M19
Environment.	Marine

7460C-7580'C

Age.	Late Triassic - Early Jurassic Undifferentiated
Zones.	P-T15 to P-M24
Environment.	Marginal Marine

7580C-7815'C

Age.	Late Triassic Undifferentiated
Zone.	Probable P-T15
Environment.	Nonmarine? - Marginal Marine

7815C-8055'C

Age.	Late Triassic Norian
Zone.	P-M26
Environment.	Marine

8055C-8120'

Age.	Triassic Undifferentiated
Zone.	Probable P-T17
Environment.	Marginal Marine

8120-8450'T.D.

Age.	Indeterminate
Environment.	Indeterminate
Remarks.	In argillite lithology by 8200 feet.

INTRODUCTION

Purpose and Scope

Micropaleo Consultants, Inc. processed for palynological study a total of 165 ditch and 19 core samples from the ExxonMobil (Exxon) Antares No. 1 (OCS-Y-0280) well. The sample coverage extended from 260 feet to the total depth of 8450 feet.

In addition to the palynological analysis, visual thermal alteration estimates (T.A.I.) and vitrinite reflectance (V.R.) measurements were conducted.

Sample material was obtained from the State of Alaska Department of Natural Resources, Geologic Materials Center in Eagle River, Alaska. The processed material and slides are on reposit at their Eagle River facility.

Procedures

The samples were processed by standard palynological techniques using hydrochloric, hydrofluoric and nitric acid treatments. The resultant kerogen residues were concentrated with heavy liquid separation and a sieving/panning procedure. Two permanent slide mounts were made for each sample with sufficient organic recoveries.

During the processing steps a fraction of the kerogen material was not treated with nitric acid and separated for the maturation analyses. These non-oxidized slurries were used to make T.A.I. slides and polished V.R. plugs.

As each palynological slide was examined, an estimate of abundance was recorded for each taxon. These data were entered into a desktop PC which then produced the basic elements for a palynomorph species distribution chart (Figure P-1).

Based on the palynomorph assemblages observed, an age and generalized environment of deposition are interpreted for the palynostratigraphic subdivisions. The environments, as interpreted from the palynological preparations, are simply categorized as nonmarine, marginal marine or marine. These categories are based on the absence or presence and diversity of microplankton cysts.

RESULTS

The species distribution chart (Figure P-1) is located in the pocket. This chart provides the palynostratigraphic subdivisions and the occurrences and estimated frequencies of observed taxa. Additionally, curves displaying the diversity and abundance of the spore-pollen and microplankton cyst assemblages in each sample are included. These curves comprise a quick reference showing intervals where an influx of marine or nonmarine assemblages may be significant.

260-350'

Age. Tertiary to Quaternary
Pliocene to Pleistocene

Environment. Nonmarine

Palynomorphs. The Pliocene - Pleistocene interval is represented by one sample and contains a nondescript spore-pollen assemblage. The assemblage included undifferentiated bisaccates, *Alnipollenites, Laevigatosporites* and *Osmundacidites*. An undescribed spore, "Spinotrilete sp.", previously known from the Pliocene - Pleistocene was also recorded.

No dinocysts were observed in this uppermost interval.

350-1190'

Age. Tertiary
Undifferentiated

Environment. Marginal Marine to Nonmarine

Palynomorphs. The spore-pollen assemblage increases in diversity and abundance through this section. The assemblage includes *Alnipollenites*, Betulaceae, *Caryapollenites, Ilexpollenites, Tiliaepollenites* and *Ulmipollenites*.

Dinocysts are rare, but the sparse assemblage consisted of the forms *Cannosphaeropsis* sp. A, *Deflandrea wetzelii, Lejeunecysta hyalina, Paralecaniella indentata* and *Spiniferites*.

Discussion. The presence of *Cannosphaeropsis* sp. A at 350 feet suggests that the top of this section is of Miocene age.

The single specimens of *Deflandrea wetzelii* and *Paraalnipollenites confusus*, if not reworked, may be indicating that Paleocene - Eocene strata are present by about 700 feet. These latter occurrences are considered to be very weak evidence.

1190-1400'

Age. Late Cretaceous
Maestrichtian

Zone. P-T11 and marginal marine equivalent

Environment. Nonmarine to Marginal Marine

Palynomorphs. The Maestrichtian interval is defined by the presence of the pollen species *Aquilapollenites magnus, Orbiculopollis globosus* and *Wodehouseia spinata*.

The marine section begins at 1310 feet with the consistent appearance of a dinocyst assemblage. The forms appearing are *Chatangiella biapertura* and *Isabelidinium cooksoniae*.

1400-1460'

Age. Late Cretaceous
Probable Campanian

Zone. Probable P-T12 and marginal marine equivalent

Environment. Marginal Marine

Palynomorphs. This thin interval is assigned a Campanian age based on the occurrence of the pollen *Aquilapollenites quadricretae* and the dinocyst *Laciniadinium biconiculum*. The qualified age assignment is due to the absence of the usual pollen marker *Aquilapollenites trialatus*; although a related form, *Aquilapollenites fusiformis*, was recorded in a sample below.

1460-2030'

Age. Late Cretaceous
Probable Santonian to Campanian

Zone. Probable P-M14

Environment. Marine

Palynomorphs. An increase in dinocyst diversity and abundance marks this subdivision. The significant taxa include various species of *Chatangiella* and the occurrences of *Hystrichosphaeridium difficile, Odontochitina operculata* and *Spiniferites* spp.

Discussion. The age assignment is put as probable because the zonal marker *Chatangiella ditissima* remains rare, and the scattered presence of *Nelsoniella aceras*, a form common to the Turonian - Coniacian interval below.

2030-2870'

Age. Late Cretaceous
Turonian to Coniacian

Zone. P-M15

Environment. Marine

Palynomorphs. The dinocyst species *Isabelidinium globosum* (= *Chytroeisphaeridia* sp.) occurs abundantly and identifies the Turonian - Coniacian interval. Other associated species include *Chlamydophorella nyei, Micrhystridium* spp. and *Odontochitina operculata*.

2870-7160'

Age. Early Cretaceous
Middle - Late Albian

Zone. P-M17

Environment. Marine

Palynomorphs. The Albian interval is defined by the appearance of a dinocyst assemblage that includes the species *Luxadinium propatulum, Palaeoperidinium cretaceum, Ovoidinium verrucosum* and *Spinidinium vestitum.*

Discussion. The pick for the top of this interval may be high and could be based on the tops of some reworked dinocyst occurrences. The lower point of 3080 feet is an alternative selection. The lower depth reflects more consistent occurrences of key forms and contains the additional appearance of the spore species *Trilobosporites perverulentus.*

Relatively sparse palynomorph recoveries were obtained below about 6900 feet in this Albian interval. Although the basal section is interpreted to be part of the Albian interval, no positive evidence was recorded to support this inclusion.

7160-7340'C

Age. Early Cretaceous
Barremian - Early Albian

Zone. P-M18a

Environment. Marine

Palynomorphs. The interval is characterized by a prolific dinocyst/acritarch assemblage. The species recorded include *Cyclonephelium distinctum, Fromea amphora, Micrhystridium* sp. A, *Odontochitina operculata, Oligosphaeridium complex* and *Senoniasphaera microreticulata*.

Discussion. The strata of this interval are very rich in amorphous organics.

7340C-7460'C

Age. Early Cretaceous
Hauterivian

Zone. P-M19

Environment. Marine

Palynomorphs. The Hauterivian section is marked by the appearance of the dinocysts *Muderongia* sp. N, *Muderongia* cf. *M. simplex, Oligosphaeridium complex* (thick-wall) and *Tubotuberella uncinata* (= *Dimidiadinium uncinatum*).

7460C-7580'C

Age. Late Triassic - Early Jurassic
Undifferentiated

Zones. P-T15 to P-M24

Environment. Marginal Marine

Palynomorphs. The significant terrestrial palynomorphs of this interval are *Classopollis classoides* and *Vitreisporites pallidus*.

The microplankton assemblage consists of *Micrhystridium* spp. These acritarchs are mainly confined to the upper half of the interval.

Dinocysts were recorded from the ditch cuttings, but the core samples indicate that these are primarily derived from up-hole.

7580C-7815'C

Age. Late Triassic
Undifferentiated

Zone. Probable P-T15

Environment. Nonmarine? - Marginal Marine

Palynomorphs. The Triassic interval has consistent occurrences of *Taeniaesporites* and *Ricciisporites*, as well as somewhat less consistent *Kraeuselisporites ressingeri* and *Taurocusporites* sp. Reworked Paleozoic spores are common in this section.

The indigenous marine species in the interval are represented by *Micrhystridium* spp., and these occur at the base of the interval. Numerous dinocysts derived from up-hole are seen in the ditch samples.

7815C-8055'C

Age. Late Triassic
Norian

Zone. P-M26

Environment. Marine

Palynomorphs. A significant decrease in spore-pollen diversity is recorded from this interval. There is also a decrease in the reworked Paleozoic spore assemblage.

Dinocyst species are the important markers for recognition of Norian strata. The principal forms are *Noricysta varivallata, Suessia swabiana* and *Sverdrupiella* sp.

8055C-8120'

Age. Triassic
Undifferentiated

Zone. Probable P-T17

Environment. Marginal Marine

Palynomorphs. This section is separated by the presence of the pollen *Lueckisporites* sp., *Ovalipollis ovalis,* and *Striatites richteri* and *Taeniaesporites* spp.

The marine component consists of the acritarch forms *Micrhystridium* spp. and *Veryhachium* spp.

Discussion. The assemblage seen in the core sample at 8114 feet is common to the Kavik Shale.

8120-8450'T.D.

Age.	Indeterminate
Environment.	Indeterminate
Palynomorphs.	The core samples within this interval indicate that these strata are essentially barren of palynomorphs.
Discussion.	The well encounters argillite lithology by 8200 feet.

CONCLUSIONS

Palynological analysis of the ExxonMobil (Exxon) Antares No. 1 (OCS-Y-0280) well provides the following generalized palynostratigraphic succession:

- Nonmarine Tertiary - Quaternary strata occur in the top sample from the depths 260 feet to 350 feet.

- Tertiary strata of marginal marine to nonmarine origin occur between 350 feet and 1190 feet. The top of the section may begin as young as Miocene, and the interval possibly includes Eocene and Paleocene age units.

- Late Cretaceous nonmarine to marine strata are subdivided between 1190 feet to 2870 feet. These include units of Maestrichtian, Campanian, possible Santonian - Campanian, and Turonian - Coniacian ages.

- Marine Middle to Late Albian strata are designated between 2870 feet and 7160 feet. The top of this interval is somewhat tentative because the most consistent occurrences of palynomorph markers is at 3080 feet.

- Marine Barremian - Early Albian strata are identified in the thin interval from 7160 feet to 7340C feet.

- A thin interval of marine Hauterivian age section is seen between 7340C feet and 7460C feet.

- A Late Triassic to Early Jurassic interval of marginal marine units is placed between 7460C feet and 7580C feet.

- Late Triassic age strata, including a marine Norian unit, are identified between 7580C feet and 8055C feet.

- Early Triassic marine strata occur from 8055C feet to 8120 feet.

- The section from 8120 feet to the total depth of 8450 feet is of indeterminate age. Argillitic basement lithology is seen as high as about 8200 feet.

KEROGEN MATURATION REPORT

Interpreted by:

Hideyo Haga

KEROGEN MATURATION

The maturation levels of kerogen residues from the ExxonMobil (Exxon) Antares No. 1 (OCS-Y-0280) well were determined by visual means, Thermal Alteration Index (T.A.I.) and by vitrinite reflectance (V.R.) measurements. A chart correlating the two methods with hydrocarbon generation is given in Figure 1.

An unoxidized fraction of selected kerogen samples were used to make T.A.I. slides and V.R. resin mounts. The V.R. resin "plugs" were cut and polished in preparation the reflectance measurements.

Thermal Alteration Index

The T.A.I. and percentage estimates for the major organic constituents are presented in Table I. A generalized organic classification scheme is used and the terminology employed may be equated to the following categories:

■	Amorphous	=	Alginite	=	Type I
■	Herbaceous	=	Exinite	=	Type II
■	Woody	=	Vitrinite	=	Type III
■	Fusinitic	=	Inertnite	=	Type IV

The T.A.I. data suggest that the mature organic facies begin below about 7000 feet. The best source potential is in strata between about 7000 feet and possibly 8000 feet.

Vitrinite Reflectance

A Leitz MPV-II photometer system and Leitz Orthoplan microscope were used to make the V.R. measurements. This equipment was integrated to a desktop computer for data recording and manipulation.

The V.R. measurements for each sample are given in Appendix A, and the calculated average V.R. (R_o) is also listed in Table I.

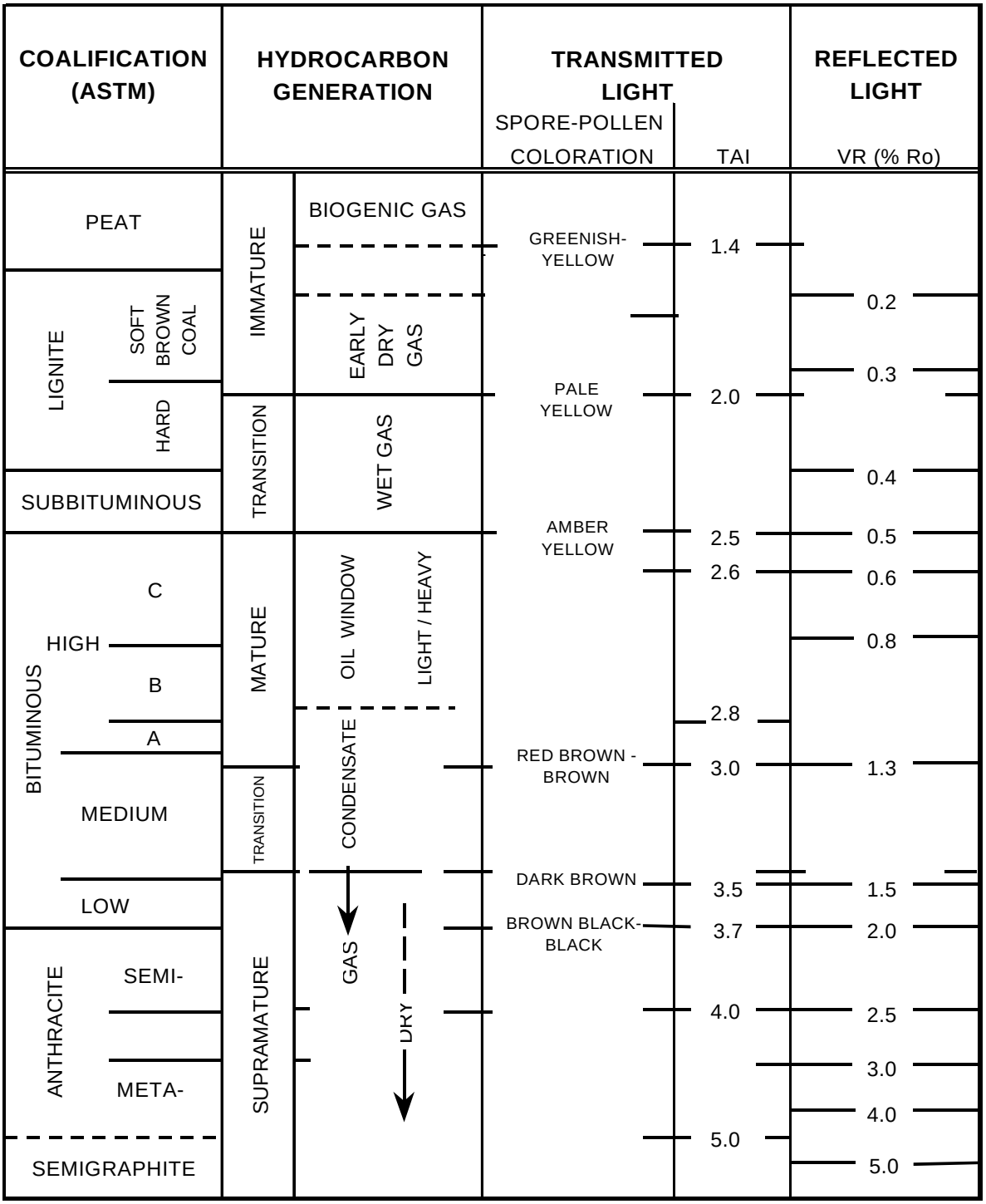


Figure 1. Correlation of Thermal Alteration Index (TAI) and Vitrinite Reflectance (VR) values to hydrocarbon generation. Modified from Heroux, Y., Chagnou, A. and Bertrand, R., (1979).

EXXONMOBIL (EXXON) Antares No.1 (OCS Y-0280)

	SAMPLE (Feet)	TAI	KEROGEN TYPES (%) A	H	W-F	VR (Avg Ro)	REMARKS
1	260-530	2.0-2.3		20	80	0.26	
2	530-710	2.0-2.3		20	80		
3	710-980	2.0-2.3		20	80		
4	980-1160	2.3		10	90		
5	1160-1430	2.3		20	80		
6	1430-1700	2.3	10	20	70		
7	1790-1970	2.3		40	60	0.45	
8	1970-2240	2.3		40	60		
9	2240-2510	2.3	10	10	80	0.44	
10	2510-2810	2.3	T	20	80		
11	2810-3110	2.0-2.3	20	20	60	0.44	
12	3110-3880	2.3	20	20	60		
13	3880-3650	2.3	20	30	50		
14	3650-3920	2.3	T	20	80		
15	3920-4190	2.3	10	20	70	0.42	
16	4190-4460	2.3	20	10	70		
17	4460-4730	2.3-2.5	20	20	60	0.45	
18	4730-5000	2.3	T	30	70		
19	5000-5270	2.3-2.5	10	30	60		
20	5270-5540	2.3-2.5	40	20	40		
21	5540-5810	2.3-2.5	20	20	60		
22	5810-6080	2.3-2.5	10	20	70	0.44	
23	6080-6350	2.3-2.5	30	10	60		
24	6350-6620	2.3-2.5	20	10	70	0.45	
25	6620-6890	2.3-2.5	30	20	50		
26	6890-7070	2.3-2.5	20	20	60		
27	7070-7340	2.5	70	10	20		
28	7250-7277.2C	2.3-2.7	60	30	10	0.49	
29	7340-7610	2.7	70	10	20		
30	7610-7880	2.7	60	20	20	0.65	Poor VR sample
31	7755-7815C	2.3-2.6	10	30	60	0.76	
32	7880-8150	2.5-2.7	60	20	20		
33	8150-8450	2.5-2.7	40	20	40	0.76	
34	8358-8379C	3.0	10	50	40		

A = amorphous, H = herbaceous (includes palynomorphs), W-F = woody-fusinitic, T = trace

Table 1 Thermal Alteration Index (TAI), percent of kerogen types, and Vitrinite Reflectance (VR).

Figure 2 displays the average V.R. for each sample in a semi-log plot. This plot illustrates that the Tertiary and younger section, which lies above 1200 feet, is in the immature range. The sharp increase in V.R. values (between 0.4 - 0.5) below 1200 feet represents the Cretaceous age units that are in the transition - mature range. Below 7700 feet another upward shift in V.R. values (between 0.6 - 0.8), to the mature facies, can be seen. These latter measurements are from the Triassic section.

The bottom core sample at 8358 feet to 8379 feet includes argillite basement. The sample was processed twice in an attempt to make a vitrinite plug, but the organic yield was inadequate for V.R. analysis.

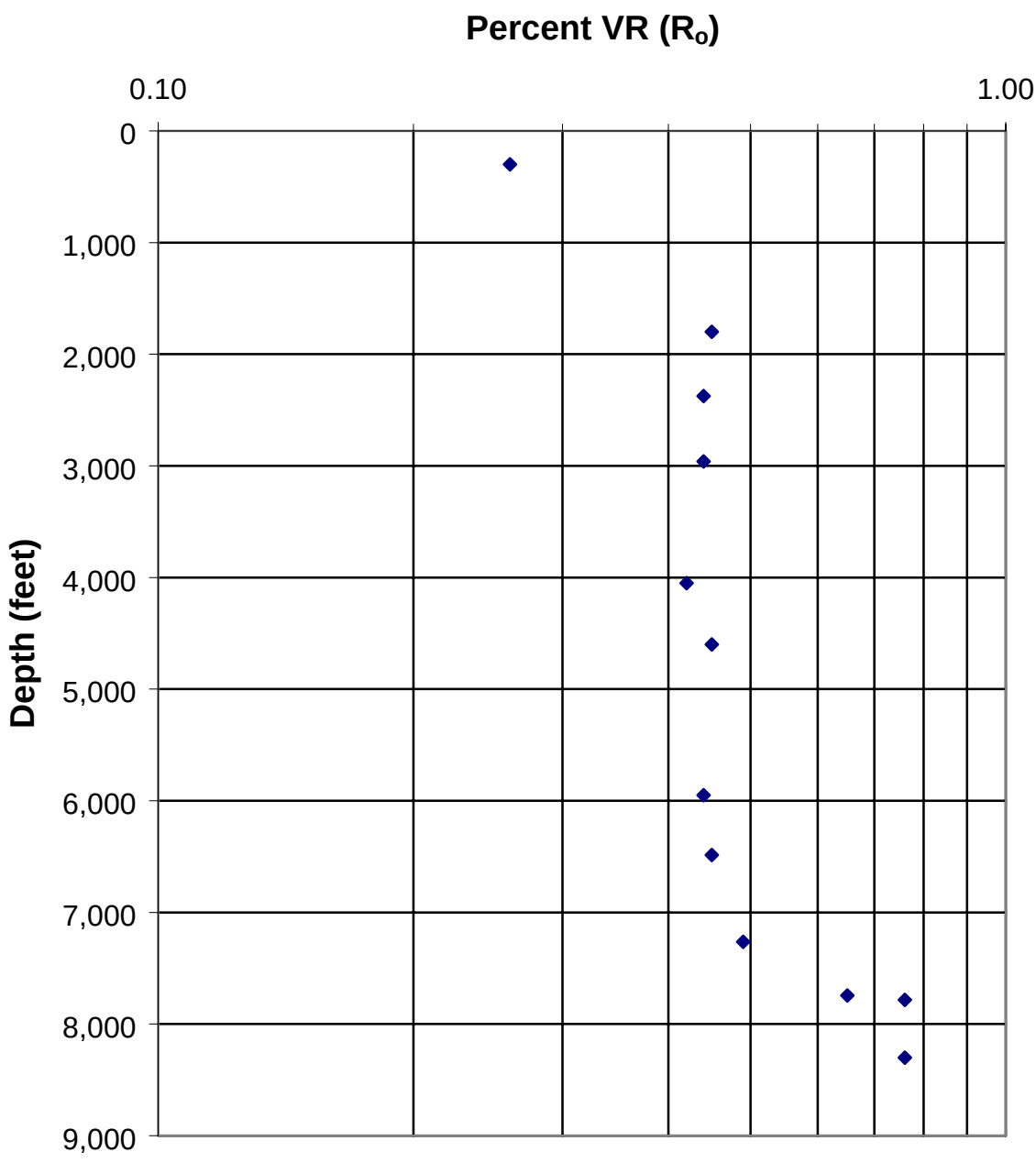


Figure 2. Plot of average R_o (%) verses depth, EXXONMOBIL (EXXON) Antares No.1 (OCS-Y-0280) well.

REFERENCE

Heroux, Y., Chagnou, A. and Bertrand, R., 1979. Compilation and correlation of major thermal maturation indicators: Bull. Am. Assoc. Petr. Geol., 63: pp. 2128-2144.

APPENDIX

VITRINITE REFLECTANCE DATA

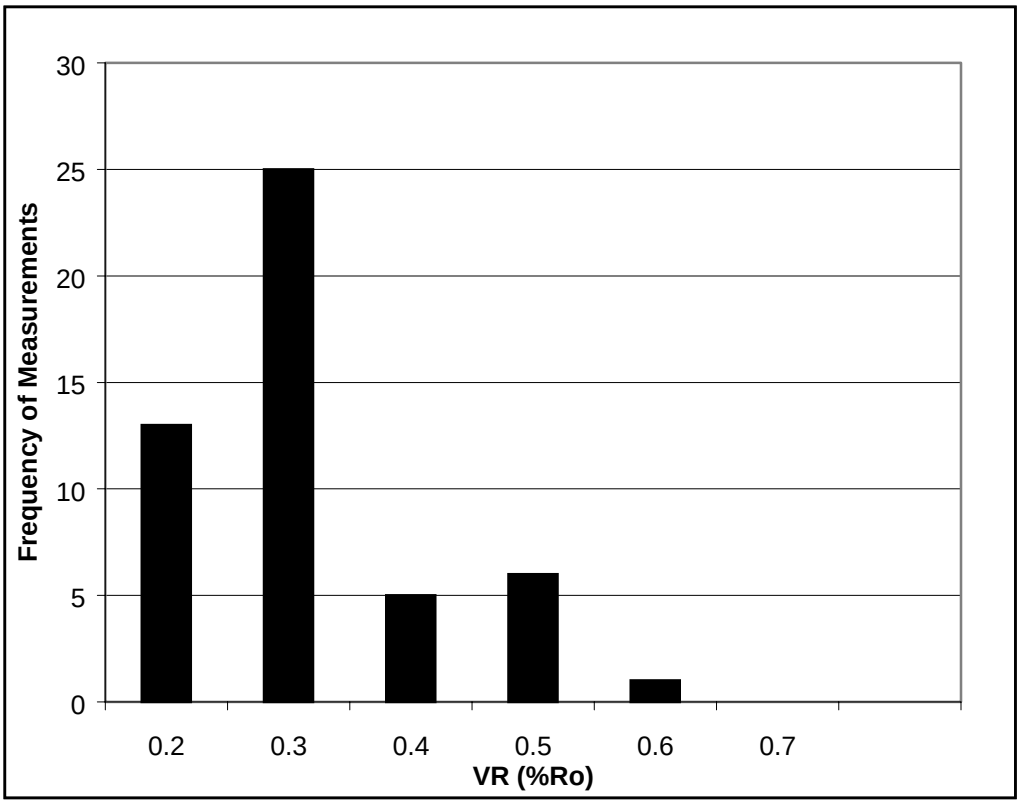
EXXONMOBIL (EXXON) Antares No.1 (OCS-Y-0280)

Sample Depth: 260-350' Ditch

VR Measurements:

0.35	0.23	0.24	0.19	0.18	
0.23	0.56	0.26	0.21	0.23	
0.24	0.20	0.19	0.21	0.24	
0.23	0.18	0.20	0.21	0.27	
0.23	0.31	0.22	0.47	0.18	
0.21	0.49	0.19	0.23	0.34	
0.29	0.19	0.20	0.22	0.20	
0.47	0.40	0.17	0.19	0.14	
0.21	0.21	0.19	0.35	0.43	
0.41	0.16	0.30	0.25	0.16	

Number of meas:	50	**Median:**	0.23
Average:	0.26	**Stand. Dev:**	0.10



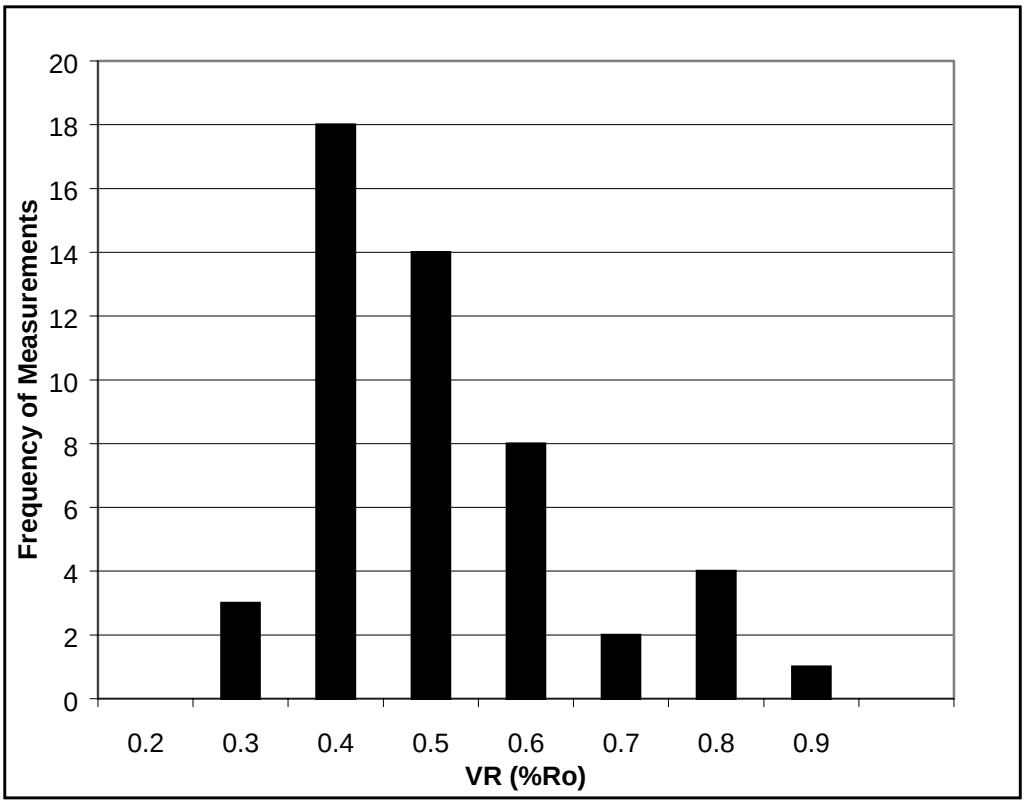
EXXONMOBIL (EXXON) Antares No.1 (OCS-Y-0280)

Sample Depth: 1790-1970' Ditch

VR Measurements:

0.33	0.28	0.51	0.30	0.30	
0.51	0.45	0.31	0.50	0.50	
0.47	0.88	0.46	0.38	0.30	
0.50	0.35	0.34	0.74	0.35	
0.68	0.37	0.58	0.40	0.34	
0.47	0.32	0.32	0.42	0.36	
0.59	0.32	0.48	0.36	0.52	
0.46	0.43	0.36	0.49	0.71	
0.63	0.46	0.26	0.76	0.42	
0.44	0.73	0.28	0.40	0.31	

Number of meas:	50	**Median:**	0.43
Average:	0.45	**Stand. Dev:**	0.14



EXXONMOBIL (EXXON) Antares No.1 (OCS-Y-0280)

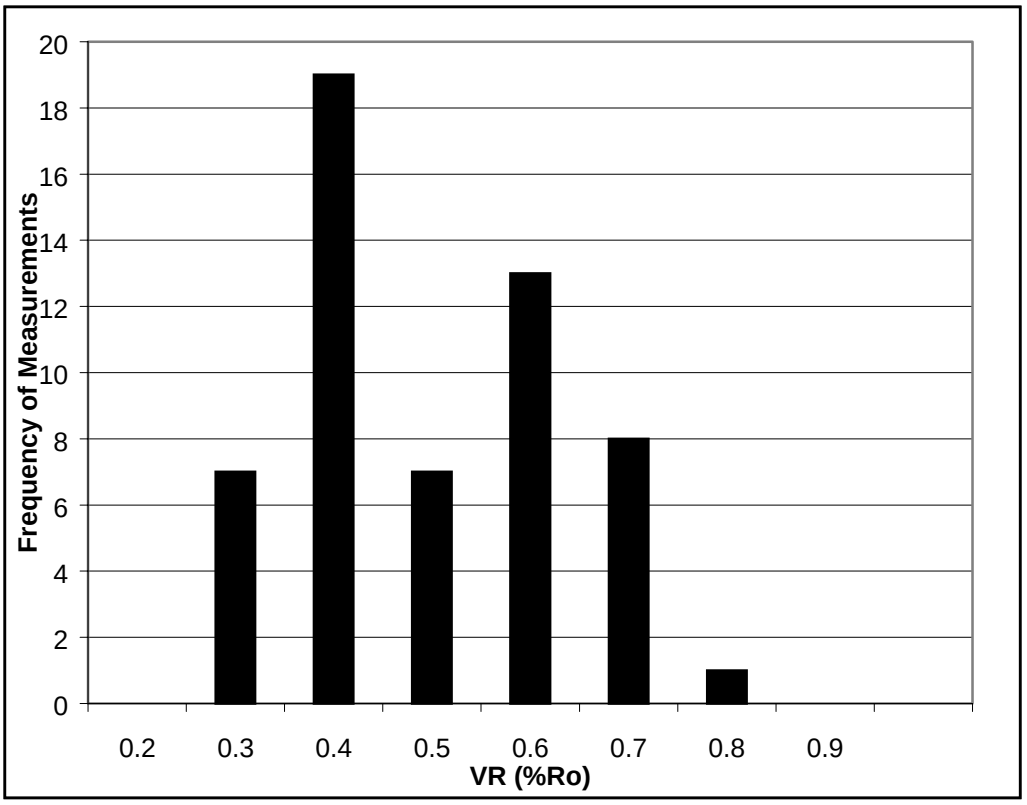
Sample Depth: 2240-2510' Ditch

VR Measurements:

0.66	0.47	0.32	0.24	0.33	0.53
0.32	0.71	0.42	0.51	0.65	0.53
0.56	0.67	0.27	0.59	0.51	0.35
0.35	0.32	0.35	0.65	0.32	0.38
0.53	0.36	0.32	0.34	0.31	0.49
0.49	0.30	0.28	0.34	0.28	
0.51	0.63	0.30	0.27	0.45	
0.54	0.51	0.69	0.49	0.38	
0.54	0.31	0.63	0.27	0.47	
0.51	0.56	0.66	0.30	0.21	

Number of meas: 55 **Median:** 0.45

Average: 0.44 **Stand. Dev:** 0.14



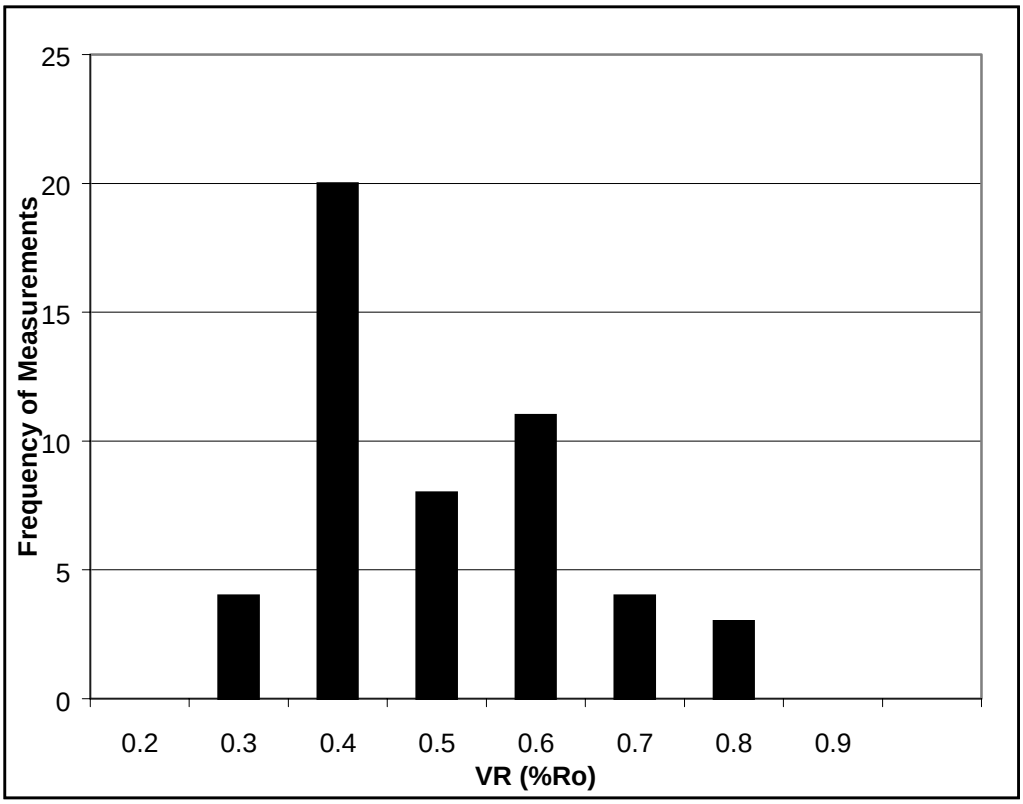
EXXONMOBIL (EXXON) Antares No.1 (OCS-Y-0280)

Sample Depth: 2810-3110' Ditch

VR Measurements:

0.23	0.36	0.39	0.39	0.42	
0.31	0.54	0.57	0.21	0.73	
0.26	0.39	0.71	0.63	0.42	
0.42	0.41	0.44	0.35	0.32	
0.34	0.34	0.64	0.60	0.30	
0.54	0.55	0.35	0.54	0.71	
0.31	0.57	0.36	0.50	0.55	
0.32	0.30	0.56	0.30	0.54	
0.30	0.32	0.68	0.58	0.27	
0.41	0.39	0.48	0.40	0.39	

Number of meas:	50	**Median:**	0.41
Average:	0.44	**Stand. Dev:**	0.14



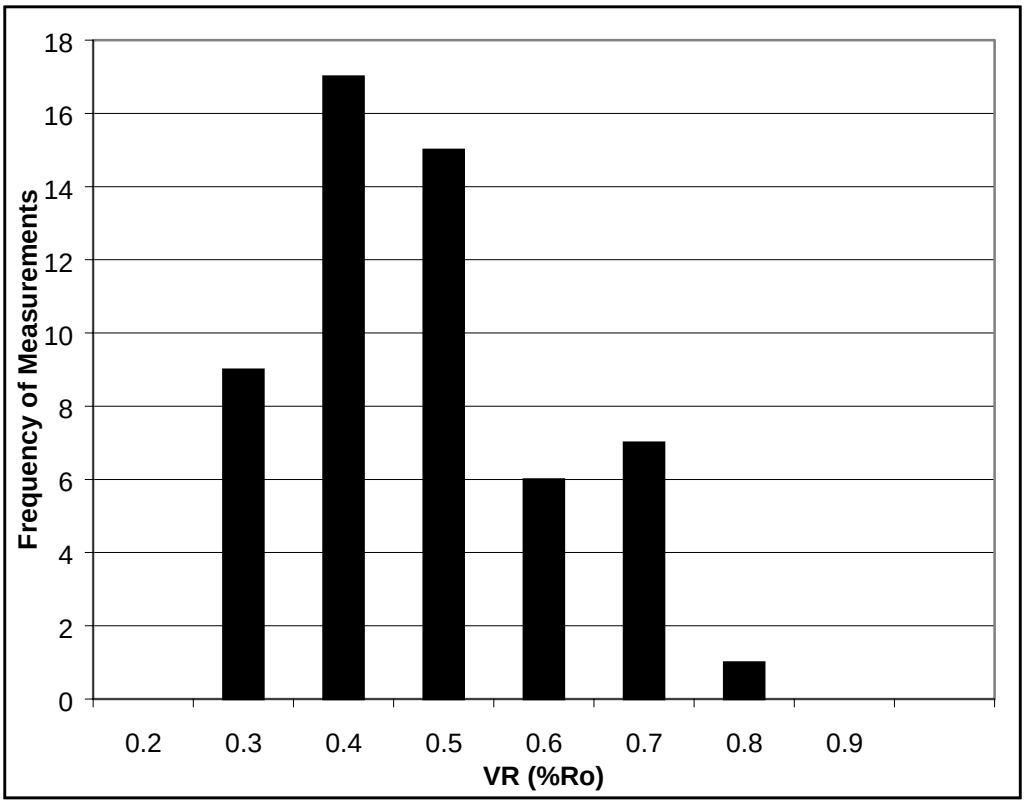
EXXONMOBIL (EXXON) Antares No.1 (OCS-Y-0280)

Sample Depth: 3920-4190' Ditch

VR Measurements:

0.35	0.43	0.42	0.69	0.26	0.32
0.32	0.40	0.45	0.48	0.37	0.66
0.29	0.31	0.50	0.78	0.39	0.39
0.43	0.33	0.30	0.28	0.46	0.67
0.43	0.26	0.21	0.54	0.48	0.55
0.64	0.65	0.47	0.25	0.32	
0.35	0.43	0.32	0.51	0.40	
0.29	0.34	0.55	0.31	0.59	
0.66	0.24	0.32	0.40	0.35	
0.36	0.64	0.27	0.44	0.47	

Number of meas:	55	**Median:**	0.40
Average:	0.42	**Stand. Dev:**	0.14



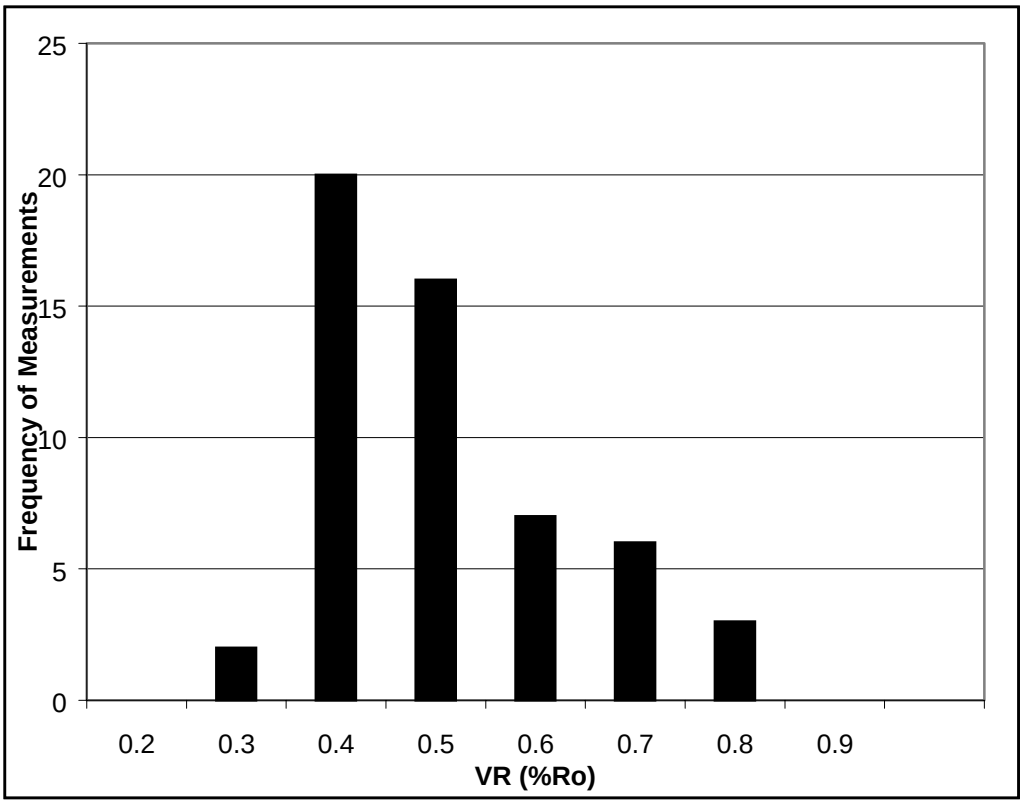
EXXONMOBIL (EXXON) Antares No.1 (OCS-Y-0280)

Sample Depth: 4460-4730' Ditch

VR Measurements:

0.50	0.40	0.29	0.35	0.43	0.38
0.58	0.53	0.37	0.47	0.62	0.41
0.42	0.47	0.60	0.39	0.41	0.76
0.33	0.36	0.60	0.33	0.56	0.47
0.31	0.38	0.47	0.76	0.66	
0.38	0.32	0.39	0.41	0.36	
0.33	0.70	0.61	0.41	0.56	
0.33	0.64	0.44	0.35	0.52	
0.46	0.35	0.46	0.37	0.43	
0.50	0.24	0.35	0.33	0.45	

Number of meas:	54	**Median:**	0.42
Average:	0.45	**Stand. Dev:**	0.12



EXXONMOBIL (EXXON) Antares No.1 (OCS-Y-0280)

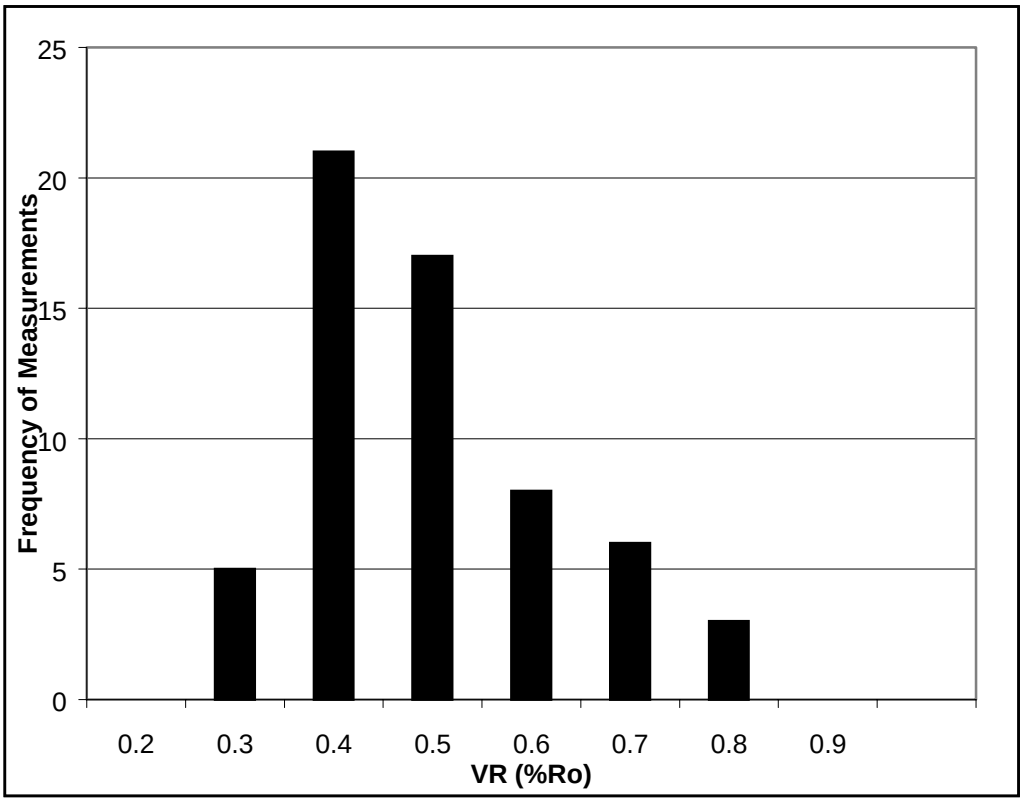
Sample Depth: 5810-6080' Ditch

VR Measurements:

0.39	0.59	0.44	0.35	0.32	0.29
0.40	0.79	0.33	0.45	0.62	0.34
0.52	0.62	0.44	0.38	0.30	0.54
0.36	0.35	0.60	0.62	0.36	0.49
0.46	0.39	0.43	0.43	0.26	0.68
0.32	0.74	0.37	0.49	0.35	0.39
0.28	0.56	0.64	0.51	0.54	0.45
0.45	0.37	0.40	0.52	0.51	0.38
0.70	0.35	0.42	0.46	0.40	0.28
0.43	0.37	0.25	0.34	0.38	0.44

Number of meas: 60 **Median:** 0.43

Average: 0.44 **Stand. Dev:** 0.12



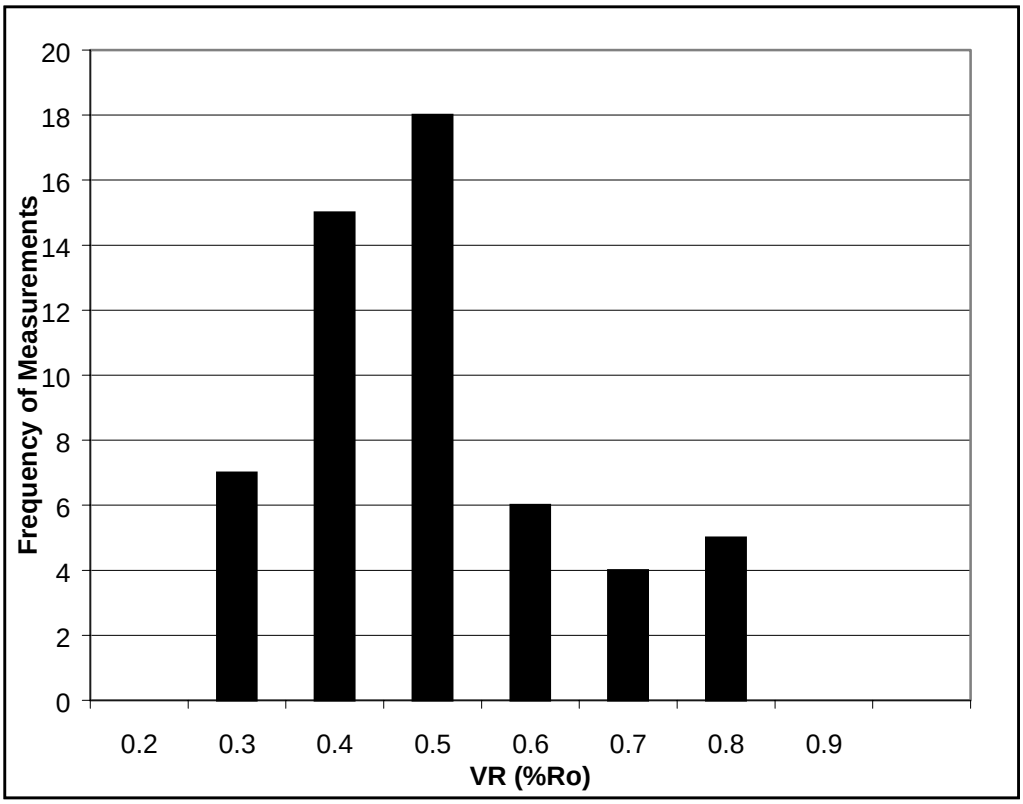
EXXONMOBIL (EXXON) Antares No.1 (OCS-Y-0280)

Sample Depth: 6350-6620' Ditch

VR Measurements:

0.37	0.38	0.42	0.67	0.26	0.32
0.72	0.51	0.29	0.38	0.27	0.28
0.47	0.33	0.58	0.31	0.51	0.76
0.40	0.65	0.39	0.38	0.45	0.47
0.63	0.41	0.36	0.54	0.44	0.38
0.46	0.47	0.45	0.31	0.38	
0.74	0.29	0.35	0.48	0.28	
0.71	0.41	0.60	0.47	0.53	
0.54	0.26	0.47	0.76	0.46	
0.44	0.32	0.41	0.39	0.45	

Number of meas:	55	**Median:**	0.44
Average:	0.45	**Stand. Dev:**	0.13



EXXONMOBIL (EXXON) Antares No.1 (OCS-Y-0280)

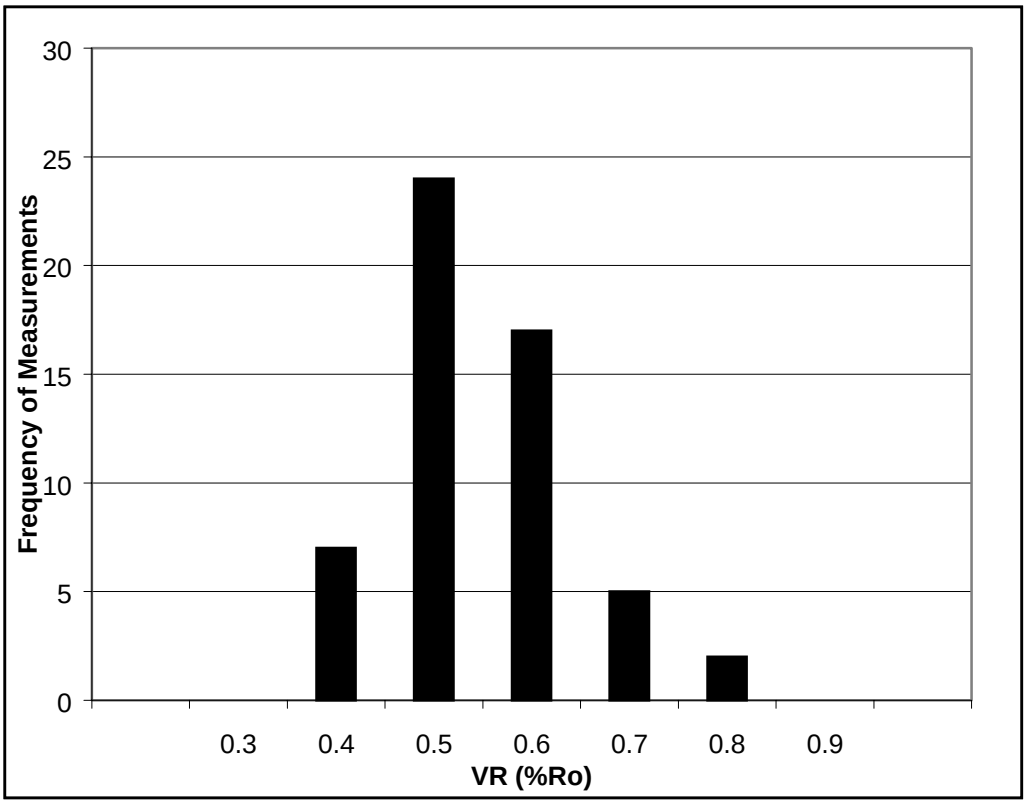
Sample Depth: 7250-7277.2' Core

VR Measurements:

0.45	0.31	0.74	0.34	0.48	0.75
0.41	0.51	0.43	0.54	0.37	0.47
0.64	0.69	0.49	0.37	0.44	0.39
0.50	0.52	0.53	0.57	0.43	0.41
0.55	0.54	0.38	0.66	0.45	0.46
0.51	0.52	0.40	0.51	0.52	
0.57	0.47	0.61	0.53	0.48	
0.56	0.52	0.39	0.49	0.54	
0.40	0.42	0.69	0.44	0.44	
0.40	0.45	0.48	0.48	0.40	

Number of meas: 55 **Median:** 0.48

Average: 0.49 **Stand. Dev:** 0.10



EXXONMOBIL (EXXON) Antares No.1 (OCS-Y-0280)

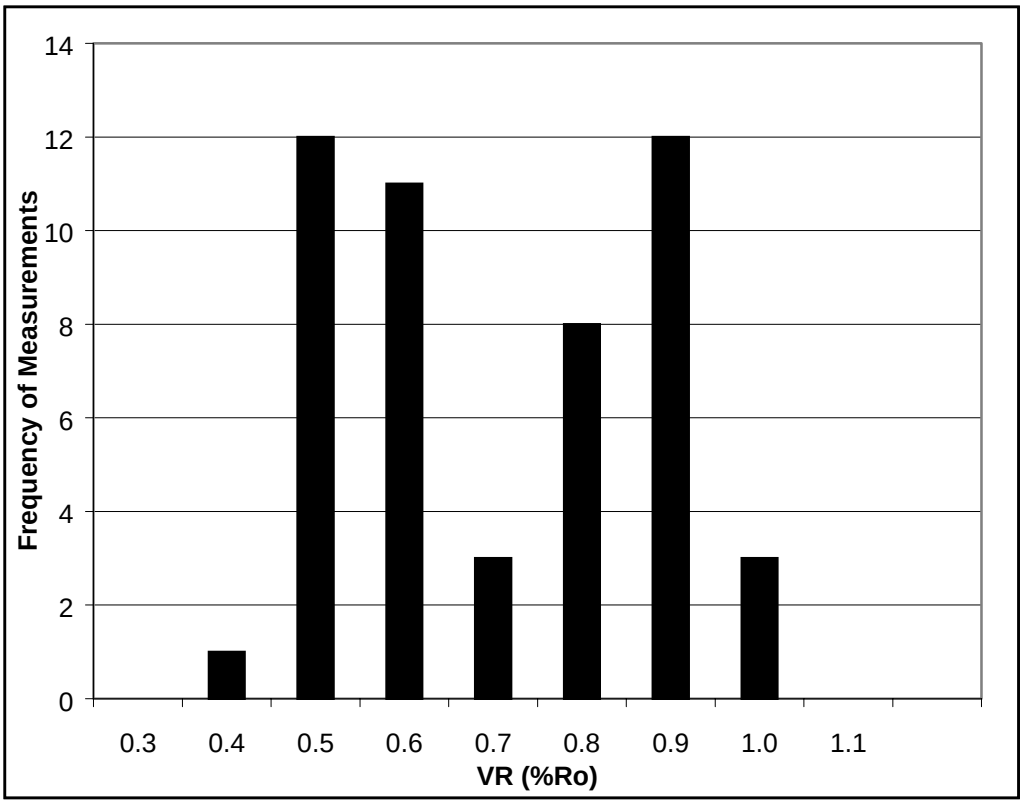
Sample Depth: 7610-7880' Ditch

VR Measurements:

0.76	0.45	0.83	0.42	0.44	
0.54	0.50	0.44	0.43	0.93	
0.49	0.85	0.84	0.79	0.42	
0.72	0.73	0.56	0.53	0.42	
0.84	0.59	0.55	0.87	0.69	
0.56	0.72	0.45	0.91	0.40	
0.56	0.46	0.38	0.54	0.80	
0.70	0.76	0.87	0.49	0.80	
0.82	0.65	0.61	0.90	0.87	
0.84	0.53	0.70	0.51	0.85	

Number of meas: 50 **Median:** 0.63

Average: 0.65 **Stand. Dev:** 0.17



EXXONMOBIL (EXXON) Antares No.1 (OCS-Y-0280)

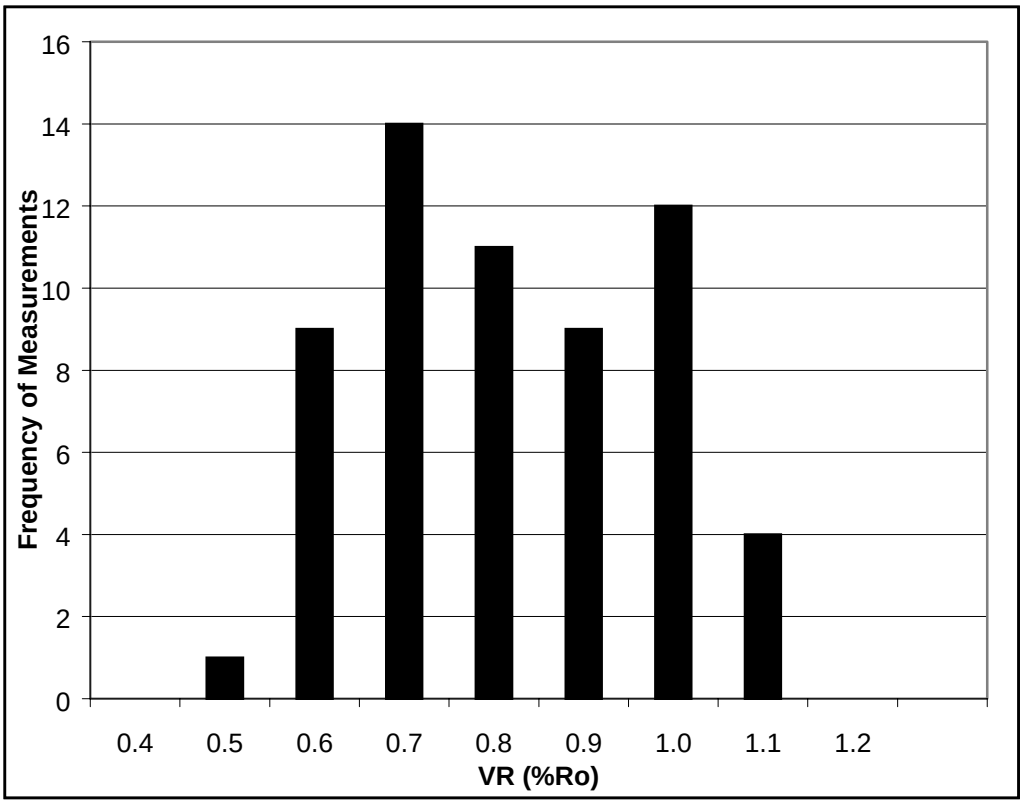
Sample Depth: 7755-7815' Core

VR Measurements:

0.74	0.65	1.02	0.65	0.66	0.66
0.98	0.65	0.58	0.60	0.86	0.85
0.89	0.97	0.64	0.56	0.87	1.02
0.77	0.75	0.73	0.55	0.98	0.85
0.51	0.60	0.97	0.93	1.07	0.48
0.96	0.55	0.71	0.54	0.61	0.57
0.93	0.62	0.72	0.99	0.91	0.58
0.97	0.99	0.82	0.80	0.60	0.55
0.74	0.72	0.96	0.68	0.67	0.64
0.83	1.07	0.73	0.73	0.85	0.74

Number of meas: 60 **Median:** 0.74

Average: 0.76 **Stand. Dev:** 0.16



EXXONMOBIL (EXXON) Antares No.1 (OCS-Y-0280)

Sample Depth: 8150-8450' Ditch

VR Measurements:

0.55	1.00	0.92	0.74	0.60	1.08	1.10
0.61	0.63	0.52	0.79	0.48	0.74	0.89
0.72	0.55	0.87	0.65	0.46	0.55	1.00
0.41	0.84	0.71	0.52	0.70	0.96	0.68
1.03	0.98	0.69	0.93	0.92	0.84	0.92
0.53	0.76	0.94	0.88	0.69	0.50	
0.74	0.75	0.94	0.64	0.54	0.79	
0.91	0.75	0.54	1.07	0.44	0.57	
1.01	1.08	0.78	1.00	0.96	0.63	
0.78	0.98	0.95	0.48	0.60	0.62	

Number of meas: 65 **Median:** 0.75

Average: 0.76 **Stand. Dev:** 0.19