MICROPALEO CONSULTANTS, INC.

UNOCAL ALASKA

TUNGAK CREEK NO. 1

API #50-207-20002

SEC. 12, T6N/R42W UM

NORTH SLOPE, ALASKA

Prepared by:

Michael B. Mickey - Foraminifera

Hideyo Haga - Palynomorphs

BIOSTRATIGRAPHY REPORT

Job No. 21-106 **May, 2002**

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Probable Early Albian

2310-8212'T.D.

Early Cretaceous
Aptian

FORAMINIFERA REPORT

Interpreted by

Michael B. Mickey

FORAMINIFERA SUMMARY

150-2310'

Age.	Early Cretaceous Probable Early Albian	
Zone.	Probable F-9	
Environment.	Nonmarine to Marginal Marine (Alluvial Plain to Transitional)	

2310-8212'T.D.

Age.	Early Cretaceous Aptian	
Zones.	F-9 to F-10	
Environment.	2310-5460':	Marginal Marine to Middle Neritic (Transitional to Middle Shelf)
	5460-8212'T.D.:	Outer Neritic to Upper Bathyal (Outer Shelf to Upper Slope)

INTRODUCTION

Scope

Micropaleo Consultants, Inc. processed, picked and analyzed for Foraminifera 90 ditch samples from the UNOCAL Alaska Tungak Creek No. 1 well. These samples covered the interval 150 to 8212 feet total depth. This work was done as part of M.C.I. Job Number 21-106.

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 paleoenvironmental plot(s) are in pockets at the back of this report.

RESULTS

150-2310'

Age.	Early Cretaceous Probable Early Albian
Zone.	Probable F-9
Environment.	Nonmarine to Marginal Marine (Alluvial Plain to Transitional)
Fauna.	Barren of Foraminifera. Megaspores and fish debris.

2310-8212'T.D.

Age.	Early Cretaceous Aptian	
Zones.	F-9 to F-10	
Environment.	2310-5460':	Marginal Marine to Middle Neritic (Transitional to Middle Shelf)
	5460-8212'T.D.:	Outer Neritic to Upper Bathyal (Outer Shelf to Upper Slope)
Fauna.	*Gaudryina* cf. *tailleuri, Pseudobolivina rayi, Saracenaria projectura, Trochammina rainwateri, T. umiatensis, Hippocrepina barksdalei, Miliammina awunensis, Haplophragmoides topagorukensis, Verneuilinoides borealis, Conorboides umiatensis, Eurycheilostoma grandstandensis, Ammobaculites fragmentarius, Lenticulina muensteri,* charophytes, ostracods and rare to frequent pyrite.	

CONCLUSIONS

The UNOCAL Alaska Tungak Creek No. 1 well penetrated the following biostratigraphic sequence based on foraminiferal analysis:

- 8062+ feet (150-8212'T.D.) of Aptian to probable Early Albian age (Early Brookian) nonmarine to outer shelf topsets and upper slope foresets.

PALYNOLOGY REPORT

Interpreted by:

Hideyo Haga

PALYNOLOGY SUMMARY

150-8212'T.D.

Age.	Early Cretaceous Aptian - Early Albian
Zone.	P-M18
Environment.	Marginal Marine

INTRODUCTION

Purpose and Scope

Micropaleo Consultants, Inc. conducted palynological analyses on 90 ditch samples from the UNOCAL Alaska Tungak Creek No. 1 well. The samples were taken between 150 feet and the total depth of 8,212 feet.

This report provides an updated format from the palynomorph data.

Procedures

The sample material was obtained from the State of Alaska, Department of Natural Resources, Geological Materials Center in Eagle Creek, Alaska. All processed material is on reposit at that facility.

The samples were processed with standard palynologic techniques using hydrochloric, hydrofluoric and nitric acid treatments. Sonification, a heavy liquid separation, and a sieving/panning technique further concentrated the resultant kerogen residues. Permanent palynology slide mounts were made for each sample with sufficient organic recoveries. The kerogen maturation samples were processed without nitric acid.

As each palynology slide was examined, an estimate of abundance for each palynomorph taxon was recorded in a microcomputer. These data form the basic elements of the species distribution chart.

Based on the palynomorph assemblages observed, an age and environment of deposition are interpreted for the palynostratigraphic subdivision. The environment, as interpreted from the palynological preparations, is merely categorized as marginal marine. This is based on the presence and relatively low diversity and abundance of microplankton.

Report Format

The following Results section gives the age, environment of deposition and significant palynomorphs. This is an expansion of the brief Summary at the beginning of this report. Following the Results are general comments in the Conclusion section. The last section of the report consists of the Kerogen Maturation Analyses.

The Palynomorph Distribution Chart (Figure P-1) lists the occurrence and abundance of recorded taxa in each sample. Included on this chart are the diversity and abundance curves for the spore-pollen and the microplankton cysts.

High Resolution Biostratigraphy Plots - Foraminifera/Palynomorphs (Figure B-1) are also provided. This chart includes additional palynology parameters in the form of a cumulative plot that illustrates the relative abundance of the nonmarine, marine and miscellaneous palynomorph components.

RESULTS

150-8212'T.D.

Age.	Early Cretaceous Aptian to Early Albian
Zone.	P-M18
Environment.	Marginal Marine
Palynomorphs.	This section is characterized by a limited diversity of Cretaceous palynomorphs. The spore-pollen assemblage includes occurrences of *Cicatricosisporites australiensis*, *Deltoidospora*, *Foraminisporis asymmetrica*, *Gleicheniidites senonicus* and *Lycopodiumsporites*. The dinocyst assemblage includes the species *Cyclonephelium distinctum*, *Oligosphaeridium complex* and *Palaeoperidinium cretaceum*. Reworked Paleozoic spores and other Jurassic, Triassic and Neocomian palynomorph species occur sporadically throughout the well.
Discussion.	This assemblage, although not highly age diagnostic based on the lack of marker species, is characteristic of the Torok Formation. In the North Slope region this negative evidence assemblage is generally assigned an Aptian - Early Albian age in the subsurface sequence.

CONCLUSIONS

Palynological analysis of the UNOCAL Alaska Tungak Creek No. 1 well provides the following palynostratigraphic subdivision:

- The entire well appears to be in the palynostratigraphic interval of Aptian - Early Albian.

- This age assignment is based mainly on negative evidence.

- Numerous reworked palynomorphs were recovered. These include specimens of Paleozoic, Triassic, Jurassic and Neocomian ages.

KEROGEN MATURATION REPORT

Interpreted by:

Hideyo Haga

KEROGEN MATURATION
(T.A.I. - VITRINITE REFLECTANCE)

Maturation levels of the kerogen residues from the UNOCAL Alaska Tungak Creek No. 1 well were determined by visual, Thermal Alteration Index (T.A.I.) estimates, and by vitrinite reflectance (V.R.) measurements. A chart correlating the two methods with hydrocarbon generation is given in Figure 1.

Unoxidized fractions 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 for the reflectance measurements.

Thermal Alteration Index

Thirty (30) T.A.I. samples were prepared and analyzed. The sample composite intervals used are essentially all at 270 feet.

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. estimates suggest that the entire well is within the mature organic facies. The values range from 2.5 to 2.8.

The organic quality indicates a dominance of gas-prone kerogen material in all of the samples.

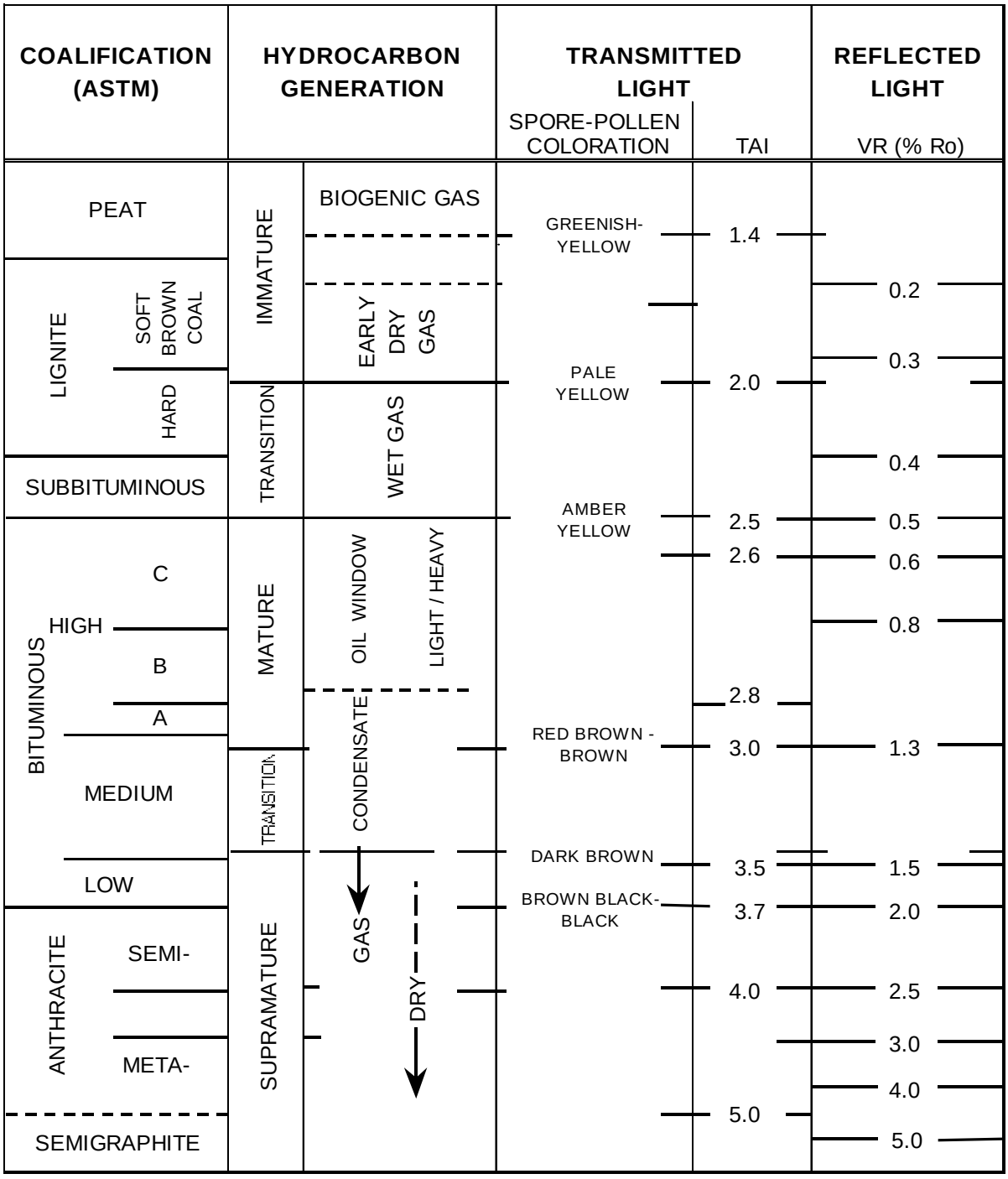


Figure 1. Correlation of Thermal Alteration Index (TAI) and Vitrinite Reflectance (VR) values to hydrocarbon generation. Modified from Heroux, Y., Chagnou, A. and Bertrand, R., (1979).

UNOCAL Tungak Creek No.1

	SAMPLE (Feet)	TAI	KEROGEN TYPES (%) A	H	W-F	VR (Avg Ro)	REMARKS
1	150-420	2.7	T	20	80		
2	420-690	2.5-2.7		10	90	0.55	
3	690-960	2.5-2.7	T	30	70		
4	960-1230	2.8	T	20	80	0.56	
5	1230-1500	2.5-2.8	10	20	70		
6	1500-1770	2.5-5.8	T	40	60	0.55	
7	1770-2040	2.5-2.8		20	80		
8	2040-2310	2.8	10	30	60	0.56	
9	2310-2580	2.5-2.8	T	20	80		
10	2580-2850	2.5-2.8	10	30	60	0.59	
11	2850-3120	2.8	T	20	80		
12	3120-3390	2.8	10	20	70	0.63	
13	3390-3660	2.8	T	30	70		
14	3660-3930	2.5-2.8	T	30	70	0.63	
15	3930-4200	2.5-5.8		30	70		
16	4200-4470	2.5-2.8		30	70	0.63	
17	4470-4740	2.5-2.8	T	40	60		
18	4740-5010	2.5-2.8	T	40	60	0.64	
19	5010-5280	2.8	T	20	80		
20	5280-5550	2.5-2.8	T	20	80		
21	5550-5820	2.5-2.8	T	20	80	0.66	
22	5820-6090	2.5-2.8	T	10	90		
23	6090-6360	2.8		10	90	0.64	
24	6360-6630	2.8		10	90		
25	6630-6900	2.8	10	20	70		
26	6900-7170	2.8	10	20	70	0.64	
27	7170-7440	2.8	T	25	75		
28	7440-7710	2.8-3.0	T	25	75	0.68	
29	7710-7980	2.8		20	80		
30	7980-8212 TD	2.8		20	80	0.67	

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).

Vitrinite Reflectance

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

Fourteen (14) samples were used for V.R. (R_o) measurements. The individual V.R. measurements, histogram plots and calculated averages are given in the Appendix. The average V.R. values of the measured samples are also included in Table I. Figure 2 is a graphic display of the average V.R. for each sample in a semi-log plot.

The V.R. averages indicate that the entire well is within the mature level for organic maturation and a slight increase in V.R. average with increased depth can be seen (Figure 2).

Because the top sample in the well is within the mature level, it suggests that the Early Cretaceous strata were previously more deeply buried.

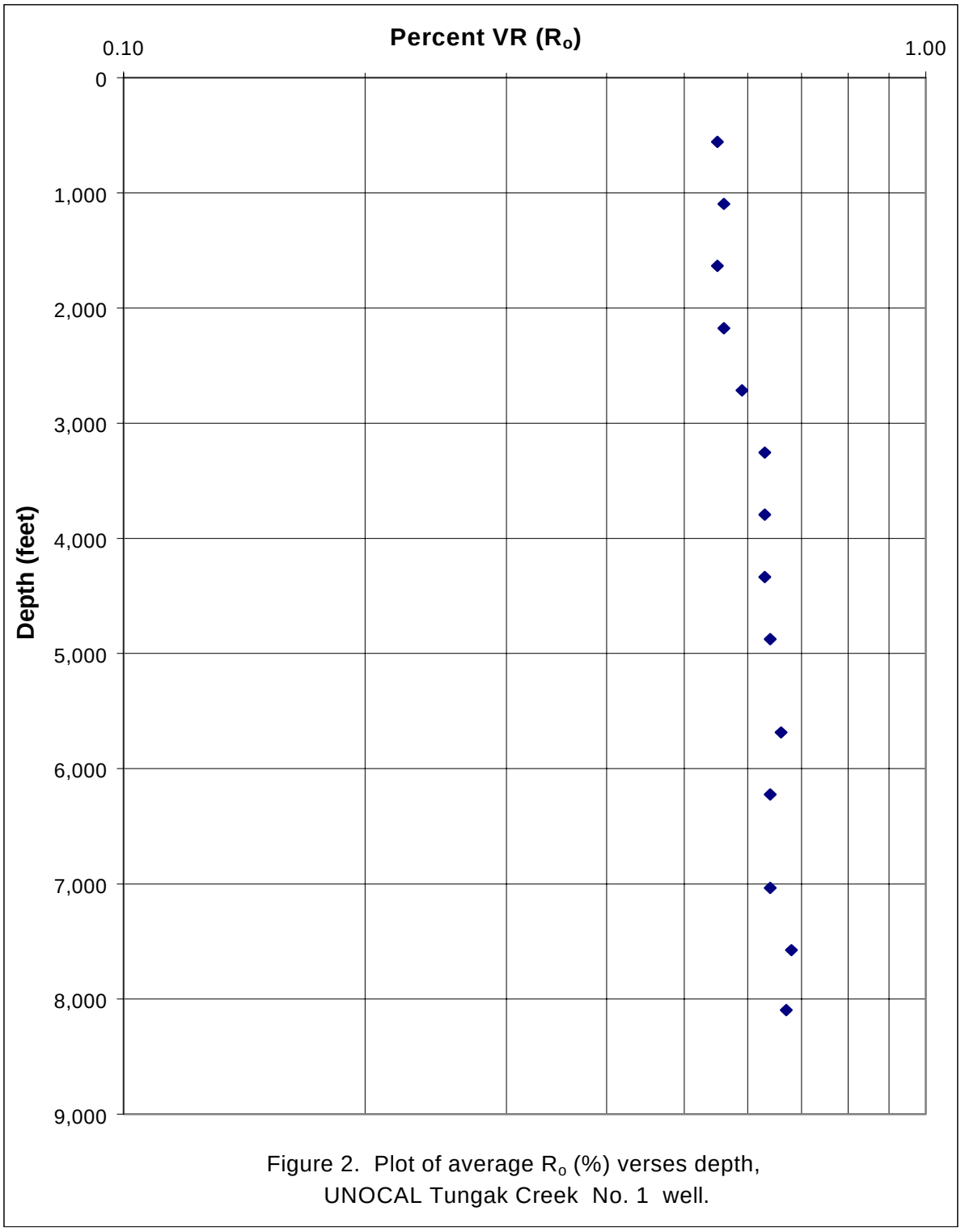


Figure 2. Plot of average R_o (%) verses depth, UNOCAL Tungak Creek No. 1 well.

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

UNOCAL Tungak Creek No.1

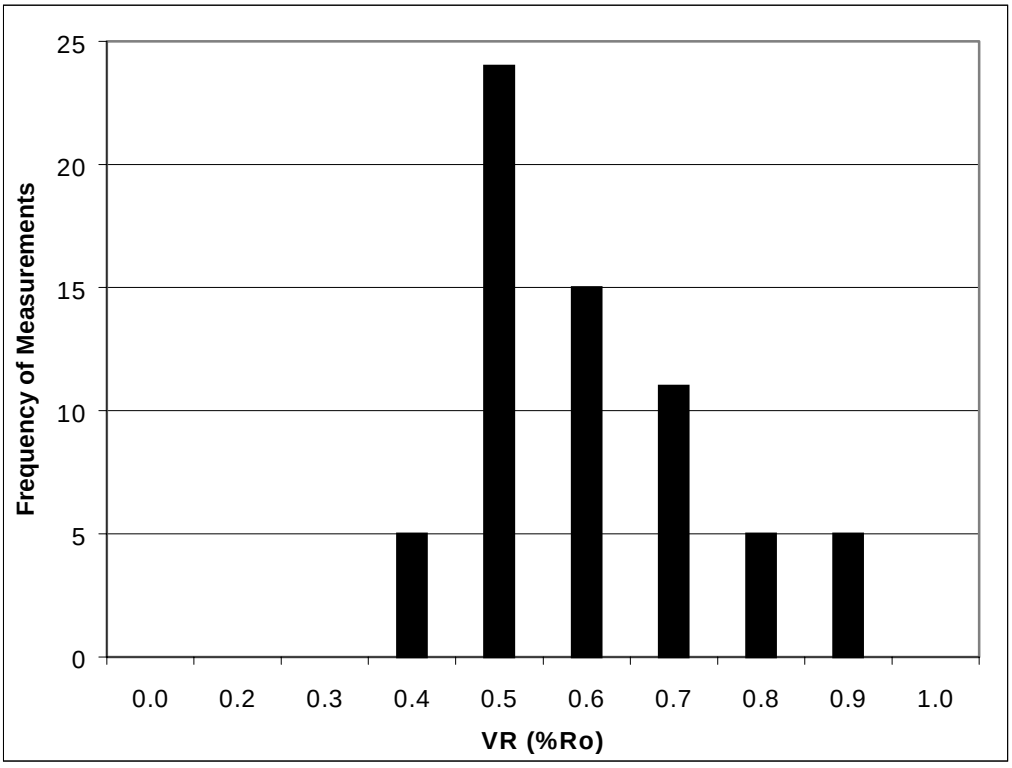
Sample Depth: 420-690' Ditch

VR Measurements:

0.40	0.30	0.37	0.38	0.43	0.39	0.37
0.41	0.40	0.40	0.45	0.43	0.42	0.42
0.44	0.40	0.40	0.47	0.48	0.43	0.51
0.46	0.46	0.47	0.63	0.52	0.43	0.65
0.47	0.48	0.52	0.63	0.57	0.47	0.72
0.52	0.48	0.58	0.65	0.57	0.48	
0.56	0.50	0.60	0.71	0.58	0.54	
0.59	0.54	0.74	0.81	0.61	0.61	
0.60	0.54	0.74	0.87	0.66	0.63	
0.69	0.58	0.85	0.88	0.86	0.79	

Number of meas: 65 **Median:** 0.52

Average: 0.55 **Stand. Dev:** 0.14



UNOCAL Tungak Creek No.1

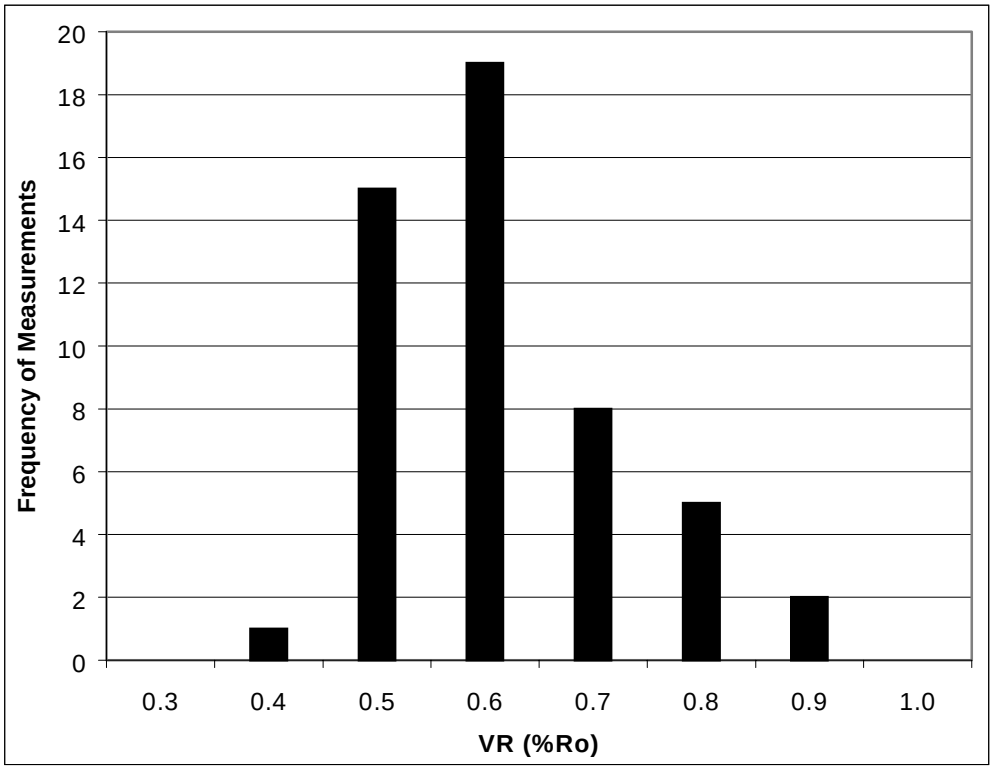
Sample Depth: 960-1230' Ditch

VR Measurements:

0.40	0.45	0.45	0.39	0.45	
0.42	0.46	0.47	0.44	0.50	
0.43	0.48	0.50	0.44	0.53	
0.45	0.48	0.52	0.46	0.56	
0.56	0.50	0.56	0.47	0.57	
0.58	0.53	0.60	0.51	0.59	
0.59	0.53	0.63	0.54	0.59	
0.60	0.67	0.66	0.59	0.59	
0.63	0.71	0.81	0.71	0.66	
0.67	0.71	0.83	0.78	0.78	

Number of meas: 50 **Median:** 0.55

Average: 0.56 **Stand. Dev:** 0.11



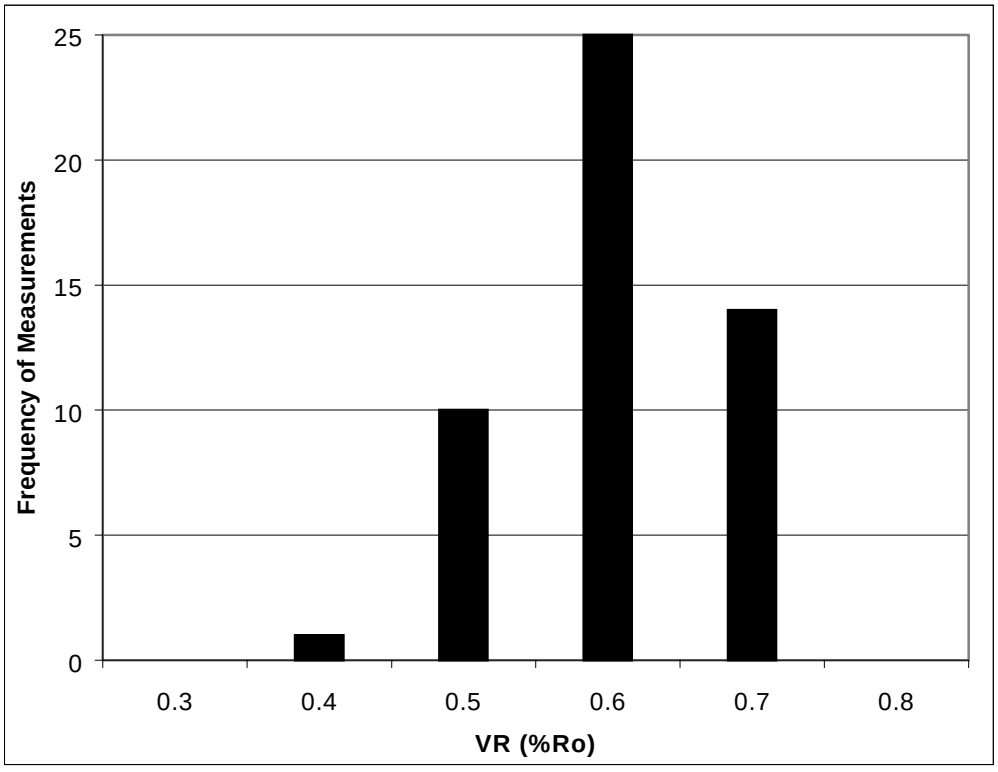
UNOCAL Tungak Creek No.1

Sample Depth: 1500-1770' Ditch

VR Measurements:

0.36	0.47	0.43	0.45	0.48	
0.43	0.53	0.43	0.46	0.51	
0.48	0.55	0.50	0.48	0.51	
0.50	0.56	0.55	0.49	0.55	
0.51	0.56	0.56	0.51	0.55	
0.56	0.56	0.56	0.53	0.58	
0.58	0.59	0.61	0.56	0.59	
0.62	0.60	0.63	0.59	0.60	
0.64	0.64	0.68	0.59	0.63	
0.65	0.66	0.68	0.69	0.67	

Number of meas:	50	**Median:**	0.56
Average:	0.55	**Stand. Dev:**	0.07



UNOCAL Tungak Creek No.1

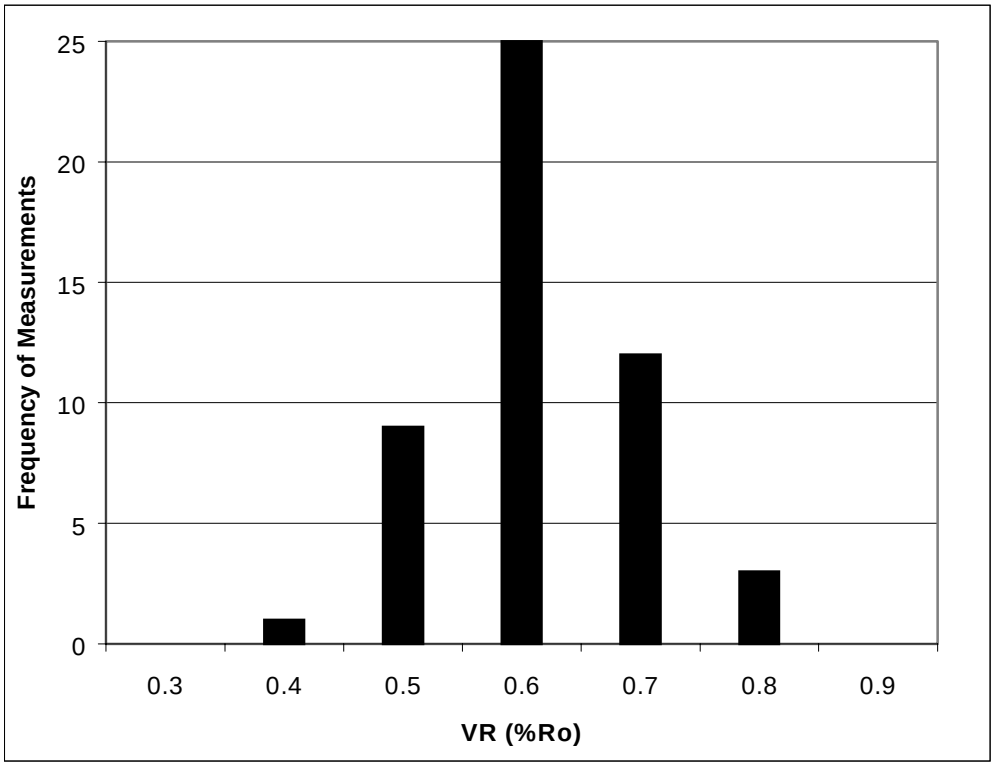
Sample Depth: 2040-2310' Ditch

VR Measurements:

0.53	0.33	0.44	0.40	0.46	
0.54	0.40	0.51	0.49	0.47	
0.55	0.46	0.51	0.55	0.47	
0.55	0.47	0.54	0.56	0.51	
0.56	0.51	0.55	0.57	0.56	
0.56	0.57	0.55	0.58	0.59	
0.62	0.58	0.56	0.59	0.60	
0.62	0.59	0.61	0.61	0.62	
0.62	0.59	0.77	0.62	0.63	
0.63	0.78	0.79	0.66	0.64	

Number of meas: 50 **Median:** 0.56

Average: 0.56 **Stand. Dev:** 0.09



UNOCAL Tungak Creek No.1

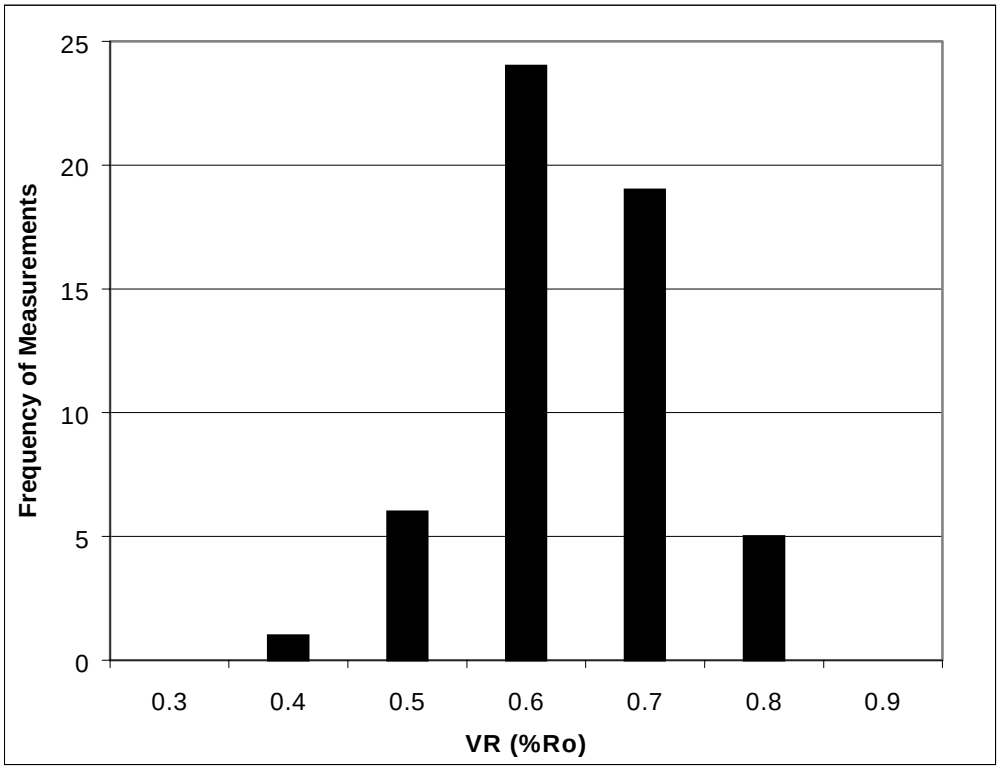
Sample Depth: 2580-2850' Ditch

VR Measurements:

0.53	0.46	0.47	0.47	0.38	0.49
0.59	0.52	0.53	0.54	0.47	0.49
0.59	0.54	0.53	0.56	0.50	0.59
0.59	0.55	0.55	0.56	0.51	0.60
0.64	0.59	0.62	0.56	0.55	0.62
0.64	0.61	0.63	0.59	0.56	
0.65	0.62	0.65	0.60	0.57	
0.68	0.63	0.66	0.62	0.58	
0.73	0.64	0.66	0.65	0.58	
0.75	0.70	0.75	0.71	0.60	

Number of meas: 55 **Median:** 0.59

Average: 0.59 **Stand. Dev:** 0.08



UNOCAL Tungak Creek No.1

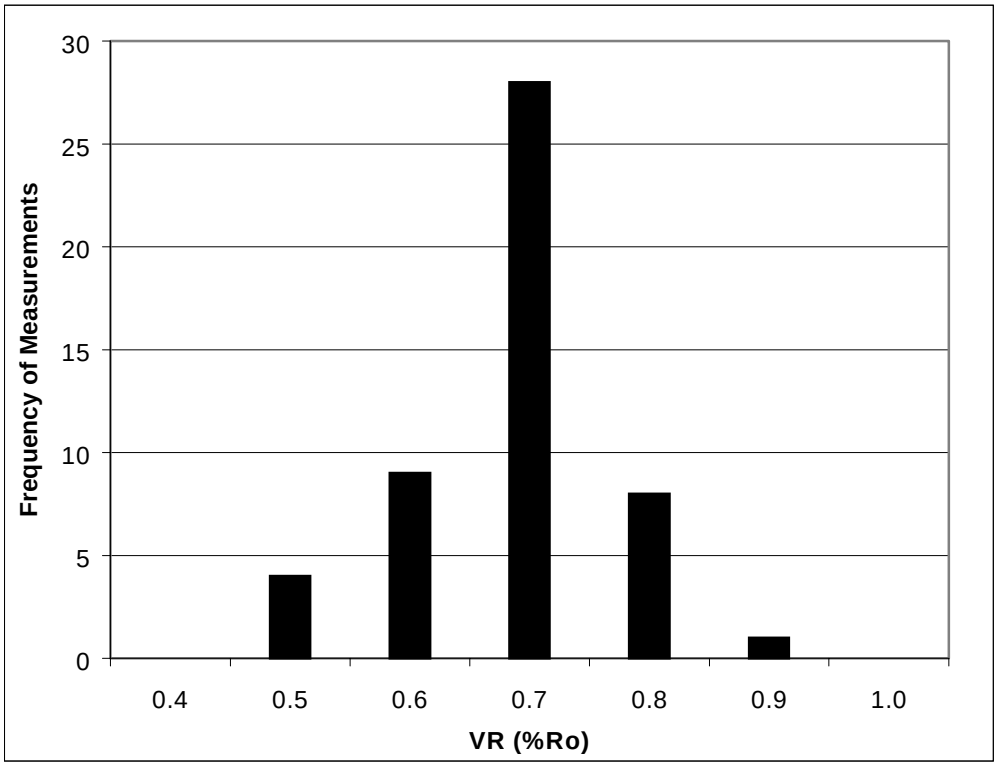
Sample Depth: 3120-3390'Ditch

VR Measurements:

0.47	0.56	0.56	0.53	0.41	
0.55	0.58	0.59	0.59	0.46	
0.63	0.59	0.59	0.60	0.49	
0.64	0.60	0.65	0.61	0.61	
0.64	0.60	0.66	0.62	0.61	
0.67	0.60	0.66	0.64	0.65	
0.68	0.62	0.66	0.67	0.71	
0.71	0.67	0.67	0.67	0.72	
0.74	0.67	0.67	0.72	0.73	
0.80	0.68	0.68	0.77	0.77	

Number of meas: 50 **Median:** 0.64

Average: 0.63 **Stand. Dev:** 0.08



UNOCAL Tungak Creek No.1

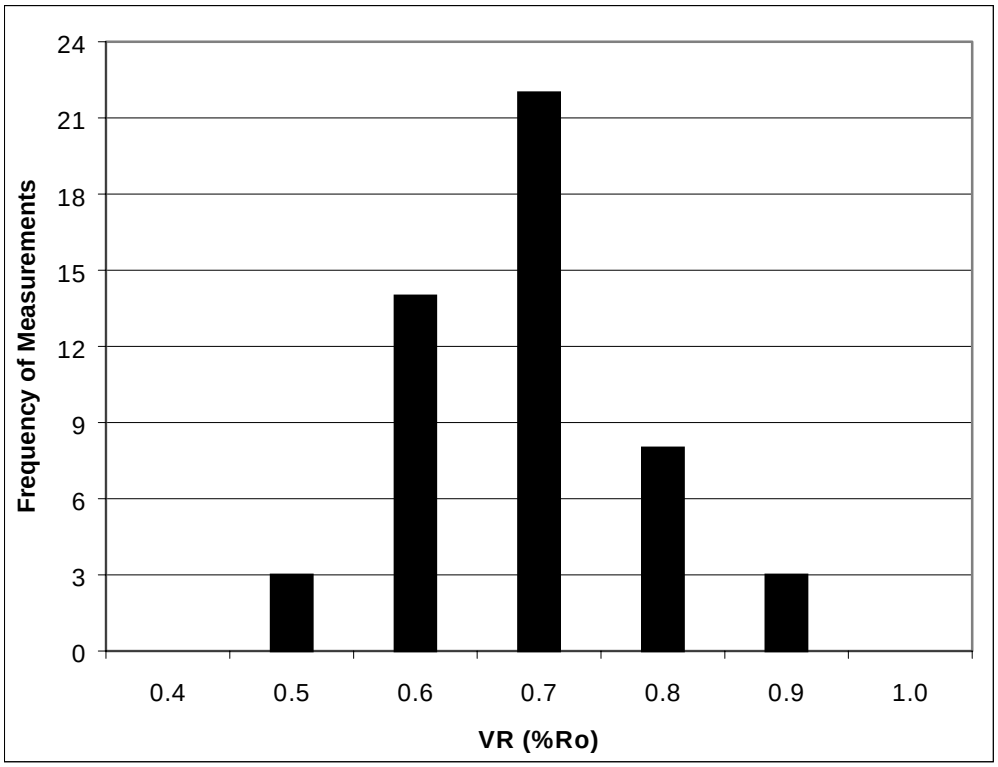
Sample Depth: 3660-3930' Ditch

VR Measurements:

0.50	0.49	0.58	0.48	0.53	
0.53	0.53	0.60	0.49	0.54	
0.54	0.56	0.62	0.52	0.58	
0.56	0.60	0.64	0.53	0.60	
0.57	0.61	0.65	0.60	0.63	
0.58	0.62	0.68	0.62	0.70	
0.64	0.63	0.70	0.63	0.73	
0.68	0.64	0.72	0.64	0.74	
0.69	0.66	0.73	0.65	0.80	
0.73	0.75	0.80	0.65	0.84	

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

Average: 0.63 **Stand. Dev:** 0.09



UNOCAL Tungak Creek No.1

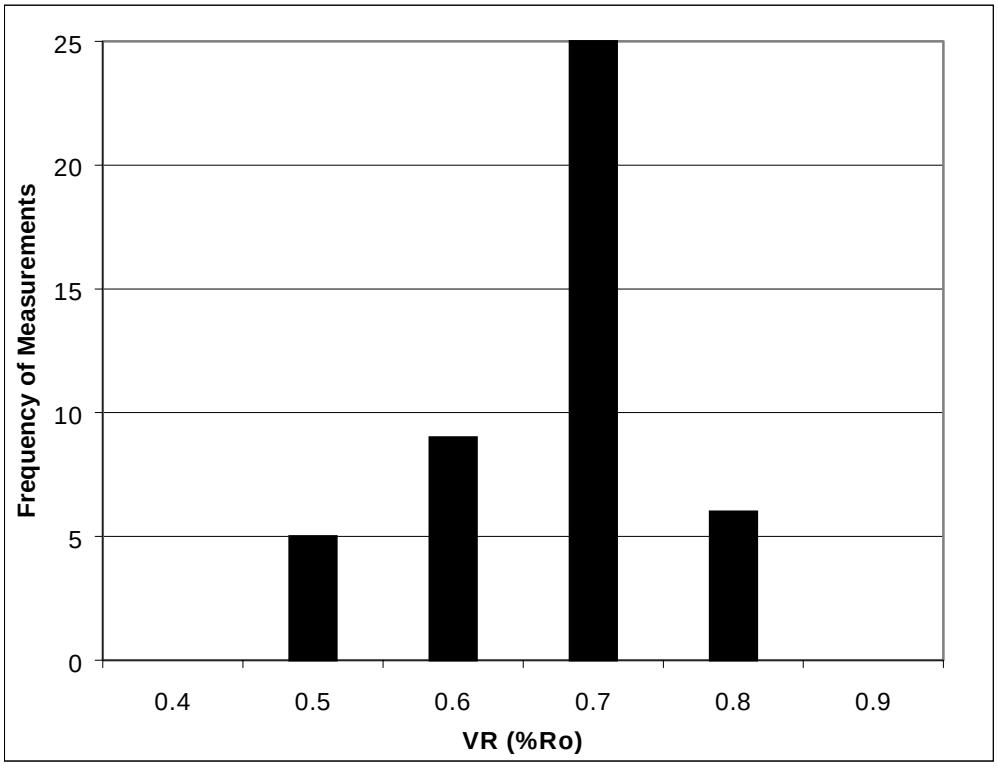
Sample Depth: 4200-4470' Ditch

VR Measurements:

0.44	0.47	0.49	0.58	0.49	
0.58	0.53	0.54	0.59	0.49	
0.61	0.57	0.55	0.64	0.59	
0.63	0.59	0.63	0.64	0.62	
0.68	0.64	0.63	0.65	0.66	
0.69	0.66	0.64	0.67		
0.69	0.68	0.64	0.67		
0.71	0.68	0.67	0.68		
0.71	0.70	0.67	0.69		
0.72	0.72	0.68	0.72		

Number of meas: 45 **Median:** 0.64

Average: 0.63 **Stand. Dev:** 0.07



UNOCAL Tungak Creek No.1

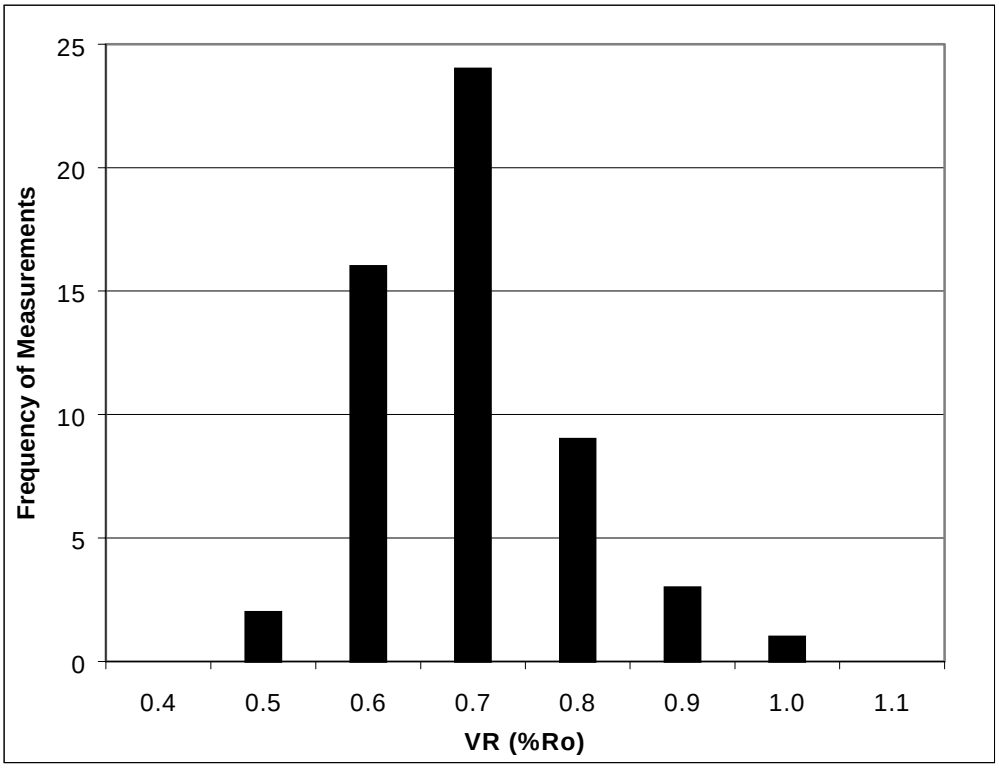
Sample Depth: 4740-5010' Ditch

VR Measurements:

0.52	0.51	0.46	0.46	0.59	0.59
0.54	0.55	0.52	0.58	0.61	0.62
0.56	0.59	0.57	0.58	0.65	0.67
0.57	0.62	0.60	0.63	0.65	0.75
0.57	0.62	0.61	0.67	0.66	0.77
0.57	0.63	0.63	0.67	0.67	
0.58	0.64	0.64	0.71	0.69	
0.66	0.65	0.68	0.72	0.70	
0.67	0.67	0.72	0.72	0.72	
0.70	0.80	0.80	0.96	0.87	

Number of meas: 55 **Median:** 0.64

Average: 0.64 **Stand. Dev:** 0.09



UNOCAL Tungak Creek No.1

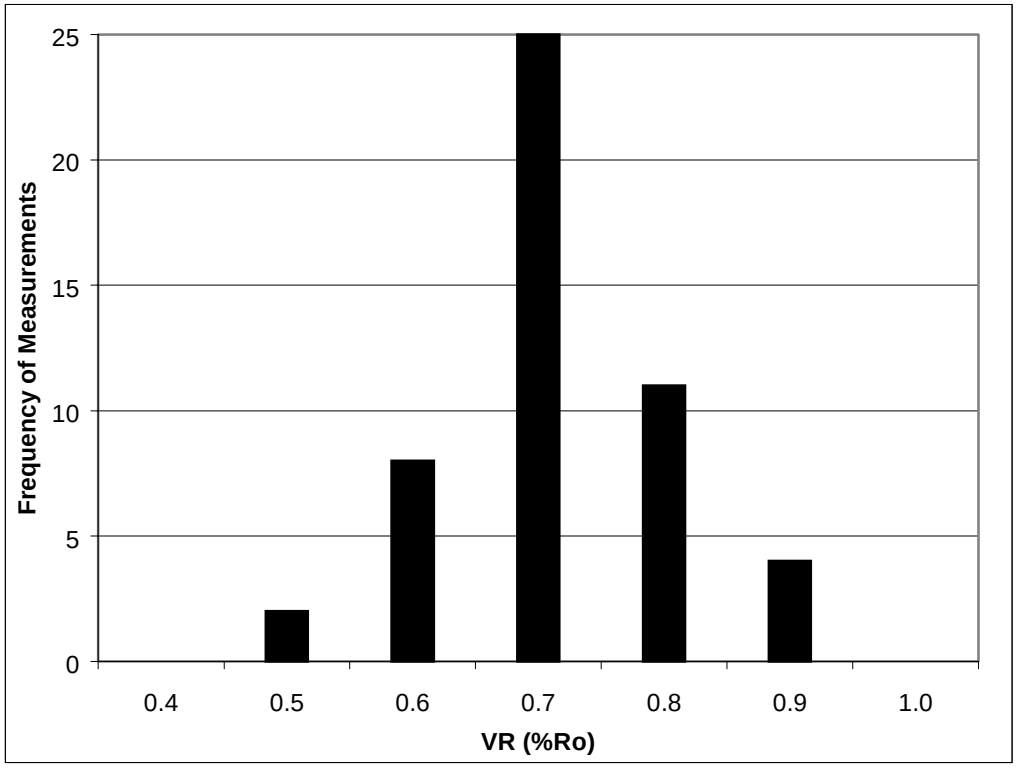
Sample Depth: 5550-5820' Ditch

VR Measurements:

0.48	0.56	0.59	0.50	0.42	
0.55	0.61	0.61	0.56	0.54	
0.58	0.62	0.62	0.60	0.54	
0.63	0.62	0.62	0.62	0.63	
0.64	0.66	0.64	0.65	0.69	
0.67	0.67	0.65	0.66	0.71	
0.71	0.68	0.65	0.66	0.72	
0.76	0.69	0.65	0.72	0.73	
0.79	0.71	0.68	0.78	0.74	
0.82	0.77	0.80	0.82	0.84	

Number of meas: 50 **Median:** 0.65

Average: 0.66 **Stand. Dev:** 0.09



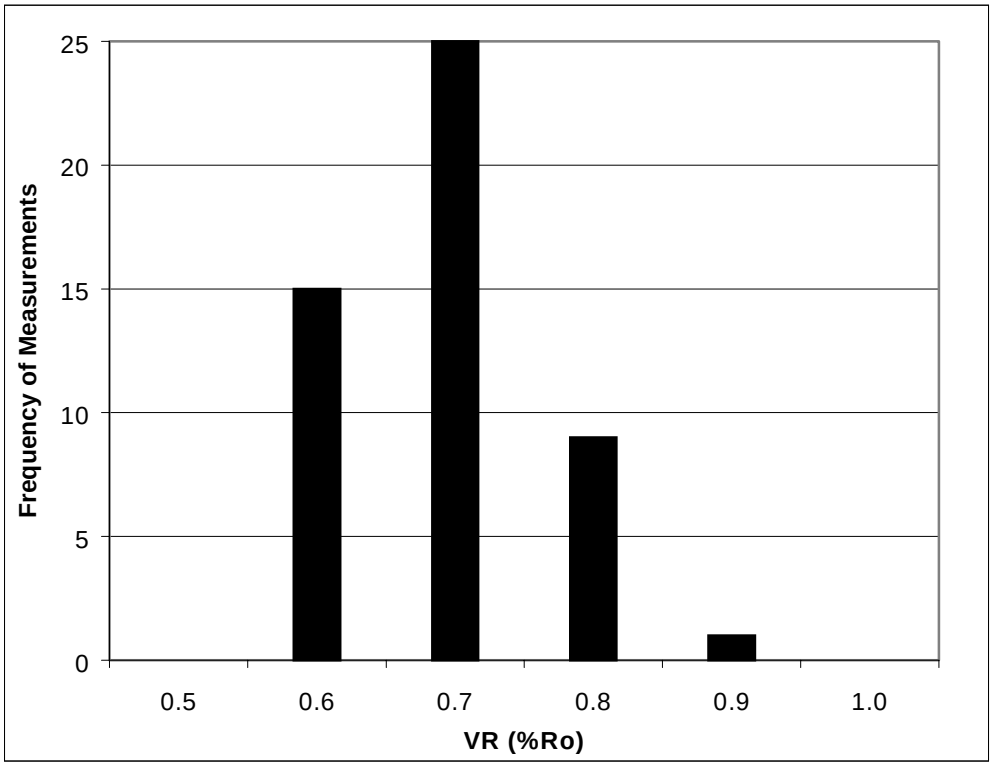
UNOCAL Tungak Creek No.1

Sample Depth: 6090-6360' Ditch

VR Measurements:

0.51	0.54	0.50	0.58	0.50	
0.54	0.64	0.52	0.59	0.54	
0.58	0.65	0.56	0.60	0.54	
0.62	0.66	0.59	0.64	0.58	
0.63	0.66	0.62	0.64	0.58	
0.65	0.68	0.63	0.68	0.62	
0.66	0.76	0.63	0.68	0.67	
0.67	0.76	0.65	0.70	0.68	
0.67	0.76	0.66	0.70	0.73	
0.76	0.88	0.66	0.72	0.77	

Number of meas:	50	**Median:**	0.65
Average:	0.64	**Stand. Dev:**	0.08



UNOCAL Tungak Creek No.1

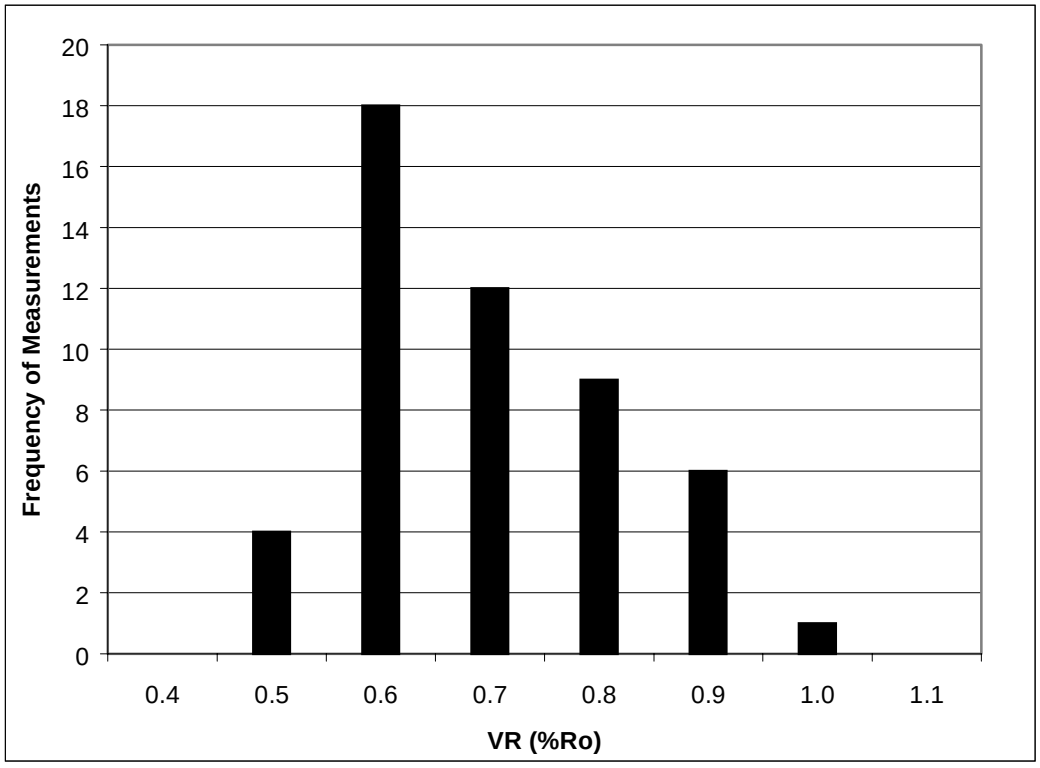
Sample Depth: 6900-7170' Ditch

VR Measurements:

0.42	0.45	0.50	0.46	0.40	
0.53	0.53	0.52	0.52	0.52	
0.56	0.58	0.56	0.55	0.53	
0.59	0.59	0.59	0.59	0.55	
0.59	0.64	0.64	0.61	0.59	
0.67	0.67	0.65	0.62	0.60	
0.70	0.77	0.67	0.63	0.69	
0.75	0.77	0.68	0.74	0.73	
0.76	0.82	0.76	0.81	0.83	
0.79	0.82	0.89	0.83	0.92	

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

Average: 0.64 **Stand. Dev:** 0.12



UNOCAL Tungak Creek No.1

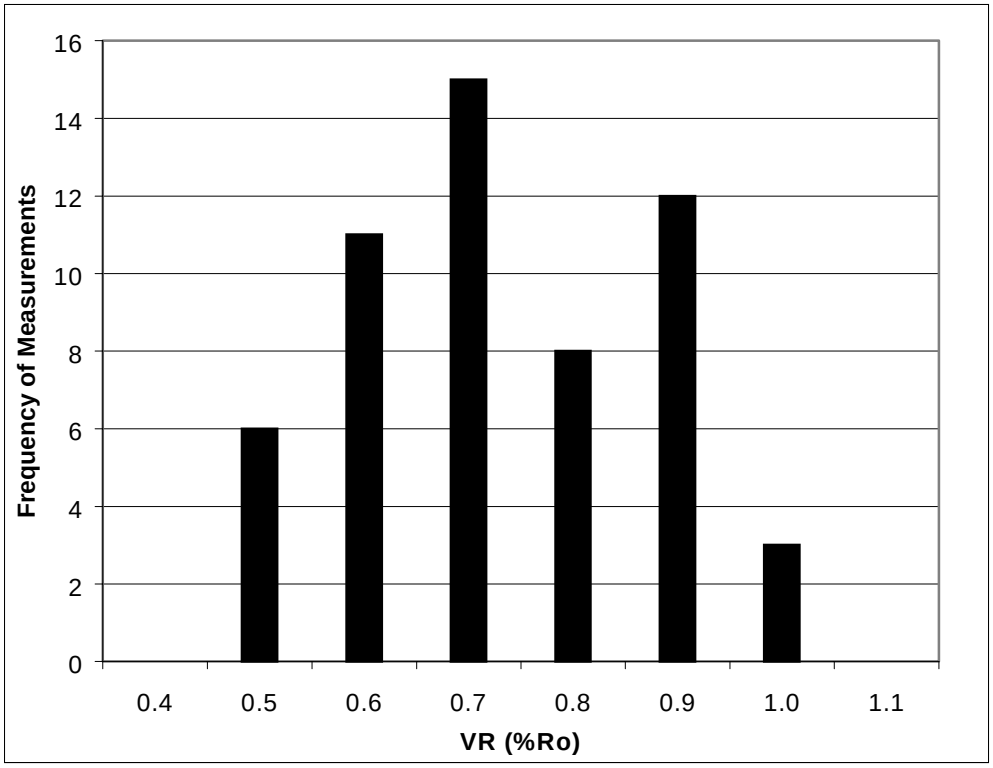
Sample Depth: 7440-7710' Ditch

VR Measurements:

0.53	0.47	0.42	0.41	0.43	0.54
0.58	0.47	0.50	0.54	0.57	0.64
0.65	0.48	0.51	0.54	0.64	0.66
0.69	0.51	0.55	0.61	0.65	0.67
0.76	0.65	0.57	0.68	0.67	0.84
0.77	0.67	0.66	0.70	0.69	
0.82	0.72	0.68	0.73	0.77	
0.86	0.76	0.73	0.81	0.82	
0.88	0.81	0.83	0.85	0.86	
0.91	0.85	0.87	0.94	0.92	

Number of meas: 55 **Median:** 0.67

Average: 0.68 **Stand. Dev:** 0.14



UNOCAL Tungak Creek No.1

Sample Depth: 7980-8212' Ditch TD

VR Measurements:

0.52	0.53	0.57	0.49	0.46	
0.56	0.56	0.57	0.58	0.53	
0.57	0.60	0.58	0.59	0.57	
0.63	0.60	0.62	0.62	0.60	
0.63	0.63	0.63	0.63	0.61	
0.64	0.64	0.76	0.64	0.64	
0.69	0.70	0.82	0.69	0.65	
0.71	0.70	0.90	0.71	0.69	
0.71	0.77	0.91	0.74	0.77	
0.93	0.81	0.94	0.77	0.97	

Number of meas:	50	**Median:**	0.64
Average:	0.67	**Stand. Dev:**	0.12