Vitrinite reflectance data and analysis of the 1,680 - 11,600 foot interval of the Phillips Kerr McGee Sullivan No. 2 well

Received 9 February 1989

Total of 22 pages in report

Geologic Materials Center Data Report No. 113

VITRINITE REFLECTANCE ANALYSIS OF THE INTERVAL 1680-11,600 FT SULLIVAN #2 WELL, ALASKA

Introduction

This report describes the vitrinite reflectance analysis of 13 cuttings samples from the Sullivan #2 oil exploration well.

Fifty vitrinite reflectance measurements for each sample are taken wherever possible utilizing a Zeiss 01K photometer attachment mounted on a Zeiss Photoscope 1. Each measurement is qualified as to poor (P), good (G) or excellent (E). Depending upon such factors as; particle size, pitting, scratching or the proximity to pyritic particles. The measurements of particles interpreted to be reworked vitrinite are labeled with an "R" while the measurements of particles interpreted to be caved material are labeled with a "C". A table and a plot of all measurements displayed as a histogram for each sample are given in Appendix A.

A vitrinite reflectance log is included which displays each histogram at the level of the sample. The material considered as caved is cross-hatched in blue while the material considered to be reworked is cross-hatched in red. The good and excellent samples are coloured in solid green while the poor measurements are coloured in cross-hatched green. Further colour copies of this log are available through the Bujak Davies Group.

The laboratory procedures for the mounting and polishing of the vitrinite samples follows the methodology described by Davies and Avery (1984) in a triple mount stub with standard 600 grit, .3 micron and .05 micron polishing procedure on Buehler Automet polishing equipment. This methodology results in a polished mount of unoxidozed kerogen.

The levels of vitrinite reflectance are compared to the Thermal Alteration Index (TAI) of Bujak, Barss & Williams (1977a,b) in Table 1 and are subdivided into various levels of thermal maturation for the generation of liquid and gaseous hydrocarbons. This generation model will vary from basin to basin depending upon the geohistory and kerogen compositions.

VITRINITE REFLECTANCE SUMMARY

Maturity Zones based on Ro

1,680-10,960ft	Onset of Maturation
11,600-11,680f	Possibly Marginally Mature

Onset of Maturation Zone: 1,680-10960ft

The zone of onset commences with the sample at 1,680ft, Ro=0.5%. Few readings were taken due to a lack of sample. The following three samples show good histogram distributions with Ro's still near 0.5% to 0.52%. At 6,070ft (Ro= 0.585%) there is very little kerogen present in the sample. The sample is mostly light grey amorphous inorganic material and should not be considered reliable. The 6,600ft sample shows an excellent histogram distribution with an Ro=0.56%. At 8,270ft there is little sample present resulting in few readings. However, the Ro=0.55% is in agreement with other samples.

Samples at 9,390ft, 9,910ft, 10,870ft and 11,600ft all contain little kerogen and vitrinite. Even though these samples have Ro's in agreement with one another, they should not be heavily relied upon.

Possible Marginally Mature Zone: 11,600-11,680ft

The deepest sample at 11,600ft contains some higher Ro vitrinite (Ro=0.62%) which appears to be from an in situ population. However this population consists only of eight readings and should not be heavily relied upon.

REFERENCES

BUJAK, J.P., BARSS, M.S. & WILLIAMS, G.L.
1977 Offshore eastern Canada Part I. Offshore east Canada's organic type and colour and hydrocarbon potential. Oil and Gas Journal, vol.75, pp.198-202.

BUJAK, J.P., BARSS, M.S. & WILLIAMS, G.L.
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DAVIES, E.H. & AVERY, M.P.
1984 A system for vitrinite reflectance analysis on dispersed organic matter for offshore eastern Canada. In: Current Research, Part A, Geological Survey of Canada, Paper 84-114, pp.367-372.

TABLE 1: TAI & Ro%

TAI	Spore colour	Approx. Ro equiv.	Amorphous kerogen	Herbaceous-woody kerogen
1	Green/Yellow		Immature	Immature
1+	Yellow	0.35%	Immature	Immature
2-	Yellow/orange	0.45%	Immature	Immature
2-to2	Orange	0.50%	Onset of maturity	Immature
2	Orange/brown	0.60%	Marginally mature	Immature
2to2+	Brown/orange	0.70%	Marginally mature	Onset of maturity
2+	Light brown	0.9%	Peak maturity	Onset of maturity
2+to3-	L.Brown/brown	1.0%	Highly mature	Peak maturity
3-	Brown	1.1%	Highly mature	Peak maturity
3-to3	Med. brown	1.2%	Highly mature	Peak maturity
3	Brown/dr.brown	1.5%	Overmature	Peak maturity
3+	Dark brown	2.0%	Overmature	Highly mature
4-	Black	2.5%	Overmature	Highly mature
4	Black/corroded	4.0%	Overmature	Overmature

Table 1: Comparison of Vitrinite Reflectance (Ro%) and the Thermal Alteration Index scale (TAI) of Bujak, Barss & Williams (1977a,b).

APPENDIX A

VITRINITE REFLECTANCE MEASUREMENTS AND HISTROGRAMS

Client: M.M.S.
Well: SULLIVAN #2
Area: ALASKA

Scientist: DUMCIUS
Date: JULY 1988
Samples are: F

VITRINITE DATA:
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Sample Depth : 1680.0

0.450		0.450		0.460		0.470		0.470		0.470		0.480
0.480		0.500		0.520		0.550		0.560		0.640		0.730 R
0.770 R		0.780 R										

Actual Mean = 0.549 Actual Standard Deviation = 0.116

Edited Mean = 0.500 Edited Standard Deviation = 0.055

Comment : Occasional pyrite; little sample present.

Sample Depth : 3600.0

0.320 C		0.340 C		0.360		0.380		0.420		0.420 P		0.430
0.430		0.430		0.450		0.460		0.460 P		0.460 P		0.470
0.470 P		0.480		0.480		0.480		0.490		0.490 P		0.500
0.500		0.510		0.520		0.520 P		0.530		0.540		0.540
0.550		0.550		0.550		0.550 P		0.560		0.560 P		0.580
0.580		0.590		0.590		0.600		0.610		0.610		0.620
0.650		0.680		0.680		0.720 R		0.730 R		0.750 R		0.770 R
0.850 R												

Actual Mean = 0.536 Actual Standard Deviation = 0.112

Edited Mean = 0.519 Edited Standard Deviation = 0.076

Comment : Occasional pyrite; fine particles; abundant degraded amorphous material present.

Sample Depth : 4240.0

0.370 C		0.390 C		0.410		0.410 E		0.420		0.420		0.430
0.440		0.440		0.450		0.450		0.460		0.460		0.460
0.460		0.460		0.460 P		0.460		0.470		0.470		0.480
0.480		0.480		0.480		0.480		0.480		0.480		0.480
0.490		0.490		0.490		0.490		0.500		0.500		0.500
0.500		0.500		0.510		0.510		0.530		0.540		0.560
0.600		0.640		0.650		0.660		0.680		0.710 R		0.720 R
0.720 R												

Actual Mean = 0.502 Actual Standard Deviation = 0.084

Edited Mean = 0.494 Edited Standard Deviation = 0.063

Comment : Occasional pyrite; fine particles; little readable vitrinite present.

Sample Depth : 4700.0

0.310 C	0.410	0.430	0.430	0.440	0.440	0.440
0.450	0.460	0.470	0.470	0.480	0.480	0.480
0.480	0.480	0.480	0.480	0.480	0.490	0.490
0.500	0.500	0.500	0.510	0.510	0.510	0.510
0.530	0.530	0.530	0.530	0.530	0.530	0.540
0.540	0.540	0.540	0.570	0.570	0.580	0.580
0.600	0.620	0.620	0.640	0.680	0.690	0.760 R
0.860 R						

Actual Mean = 0.524 Actual Standard Deviation = 0.091

Edited Mean = 0.517 Edited Standard Deviation = 0.064

Comment : Occasional pyrite; fine particles; little vitrinite present.

Sample Depth : 6070.0

0.490	0.680 P	1.060 R	1.420 R	1.650 R		

Actual Mean = 1.060 Actual Standard Deviation = 0.487

Edited Mean = 0.585 Edited Standard Deviation = 0.134

Comment : Very little kerogen present.

Sample Depth : 6600.0

0.400	0.440	0.440	0.460	0.470	0.490	0.500
0.510	0.520	0.520	0.530	0.540	0.540	0.540
0.540	0.540	0.540	0.550	0.550	0.550	0.560
0.560	0.560	0.560	0.600	0.600	0.610	0.640
0.640	0.640	0.650	0.680	0.680	0.710	0.760
0.960 R						

Actual Mean = 0.572 Actual Standard Deviation = 0.103

Edited Mean = 0.561 Edited Standard Deviation = 0.079

Comment : Little kerogen and vitrinite present.

Sample Depth : 7160.0

0.420	0.430	0.450	0.450	0.460	0.480	0.490
0.500	0.500	0.510	0.510	0.510	0.510	0.520
0.540	0.540	0.550	0.550	0.560	0.560	0.560
0.580	0.580	0.590	0.590	0.590	0.600	0.610
0.610	0.620	0.620	0.630	0.640	0.650	0.650
0.660	0.660	0.660	0.680	0.700	0.710	0.710
0.720	0.720	0.720	0.730	0.730	0.770	0.820 R
0.840 R						

Actual Mean = 0.600 Actual Standard Deviation = 0.101

Edited Mean = 0.590 Edited Standard Deviation = 0.091

Comment : Occasional pyrite; little kerogen; occasional large vitrinite particles present.

Sample Depth : 7740.0

0.440		0.440		0.450		0.460		0.460		0.460		0.460	
0.460		0.480		0.480		0.480		0.500		0.500		0.510	
0.520		0.530		0.530		0.530		0.560		0.560		0.560	
0.560		0.590		0.590		0.590		0.590		0.600		0.600	
0.600		0.650		0.660		0.670		0.670		0.670		0.680	
0.680		0.690		0.780	R	0.810	R	0.820	R				

Actual Mean = 0.572 Actual Standard Deviation = 0.102

Edited Mean = 0.553 Edited Standard Deviation = 0.080

Comment : Occasional pyrite; abundant fine particles present.

Sample Depth : 8270.0

0.390	C	0.420		0.460		0.490	P	0.500		0.520		0.530	
0.570		0.580	P	0.620		0.670		0.700		0.710	R	0.830	R
0.890	R												

Actual Mean = 0.592 Actual Standard Deviation = 0.145

Edited Mean = 0.551 Edited Standard Deviation = 0.087

Comment : Very little sample present.

Sample Depth : 9390.0

0.390	C	0.430	C	0.460		0.490		0.490		0.500		0.500	
0.530		0.530		0.530		0.540		0.540		0.550		0.570	
0.570		0.580		0.610		0.640		0.660		0.660		0.770	R
0.780	R	0.780	R	0.790	R	0.830	R	0.830	R	0.840	R	0.890	R
0.970	R	0.990	R										

Actual Mean = 0.641 Actual Standard Deviation = 0.165

Edited Mean = 0.553 Edited Standard Deviation = 0.059

Comment : Occasional pyrite; little kerogen and vitrinite present.

Sample Depth : 9910.0

0.420	C	0.430	C	0.450		0.480		0.500		0.520		0.540	
0.540		0.550		0.590		0.600		0.600		0.610	P	0.660	
0.710	R	0.730	R	0.740	R	0.750	R	0.780	R	0.800	R	0.850	R
0.900	R	0.920	R	1.050	R								

Actual Mean = 0.655 Actual Standard Deviation = 0.169

Edited Mean = 0.553 Edited Standard Deviation = 0.061

Comment : Occasional pyrite; little kerogen and vitrinite present.

Sample Depth : 10870.0

0.430	C	0.430	C	0.440		0.450		0.460		0.460		0.460	
0.470		0.470		0.480		0.480		0.490		0.490		0.490	
0.500		0.500		0.500		0.510		0.510		0.510		0.540	
0.550		0.560		0.560		0.580		0.580		0.680		0.710	R
0.780	R												

Actual Mean = 0.520 Actual Standard Deviation = 0.083

Edited Mean = 0.509 Edited Standard Deviation = 0.053

Comment : Occasional pyrite; little kerogen and vitrinite present.

Sample Depth : 11600.0

0.350	C	0.390	C	0.410	C	0.410	C	0.420	C	0.420	C	0.420	C
0.430	C	0.430	C	0.440	C	0.440	C	0.440	C	0.450	C	0.460	C
0.460	C	0.470	C	0.470	C	0.470	C	0.490	C	0.500	C	0.500	C
0.510	C	0.510	C	0.510	C	0.520	C	0.540		0.560		0.630	
0.630		0.630		0.630		0.650		0.680		0.780	R	0.840	R

Actual Mean = 0.511 Actual Standard Deviation = 0.111

Edited Mean = 0.619 Edited Standard Deviation = 0.046

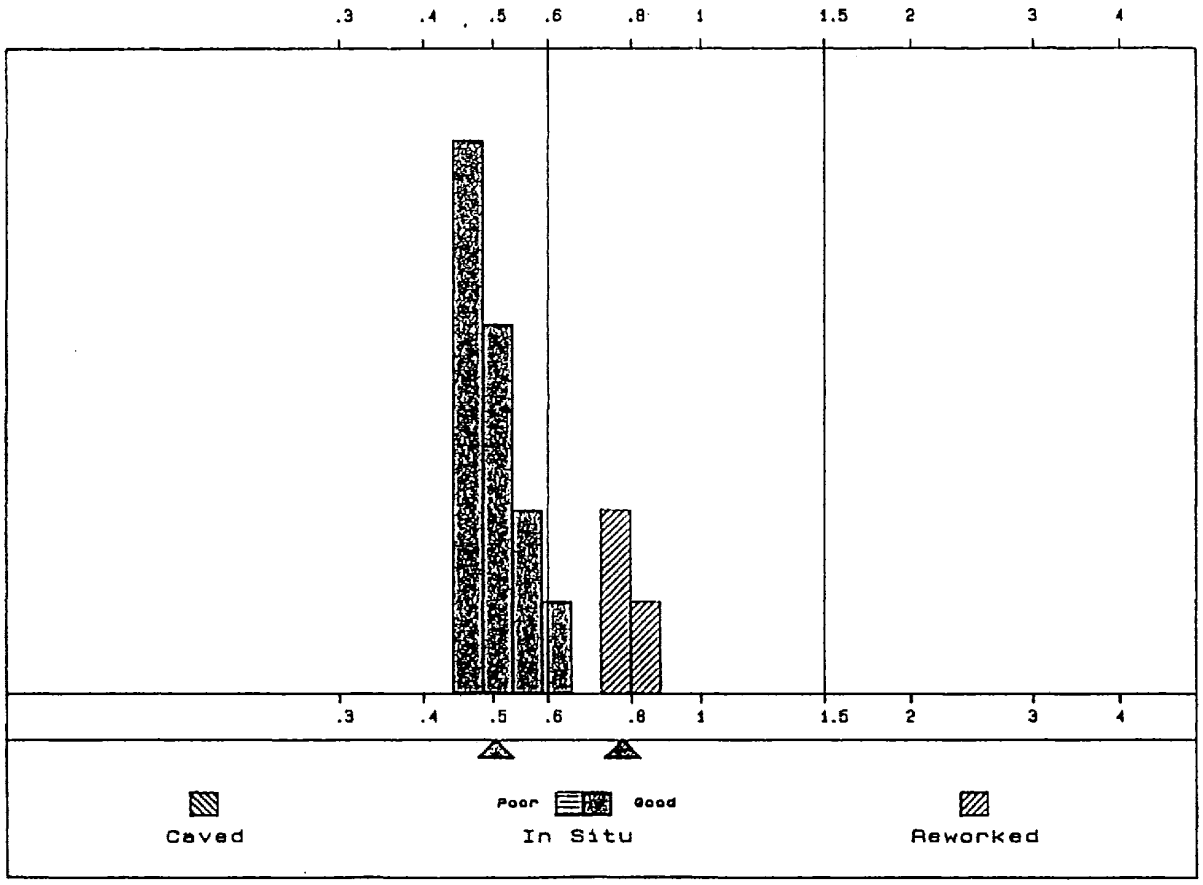
Comment : Occasional pyrite; little kerogen present.

BUJAK DAVIES GROUP : VITRINITE SULLIVAN #2

SAMPLE : 1680f

Population	Mean	Standard Deviation
In Situ	0.50	0.05
Caved	-	-
Reworked	0.76	0.03
Total	0.55	0.12

Total measurements this sample : 16

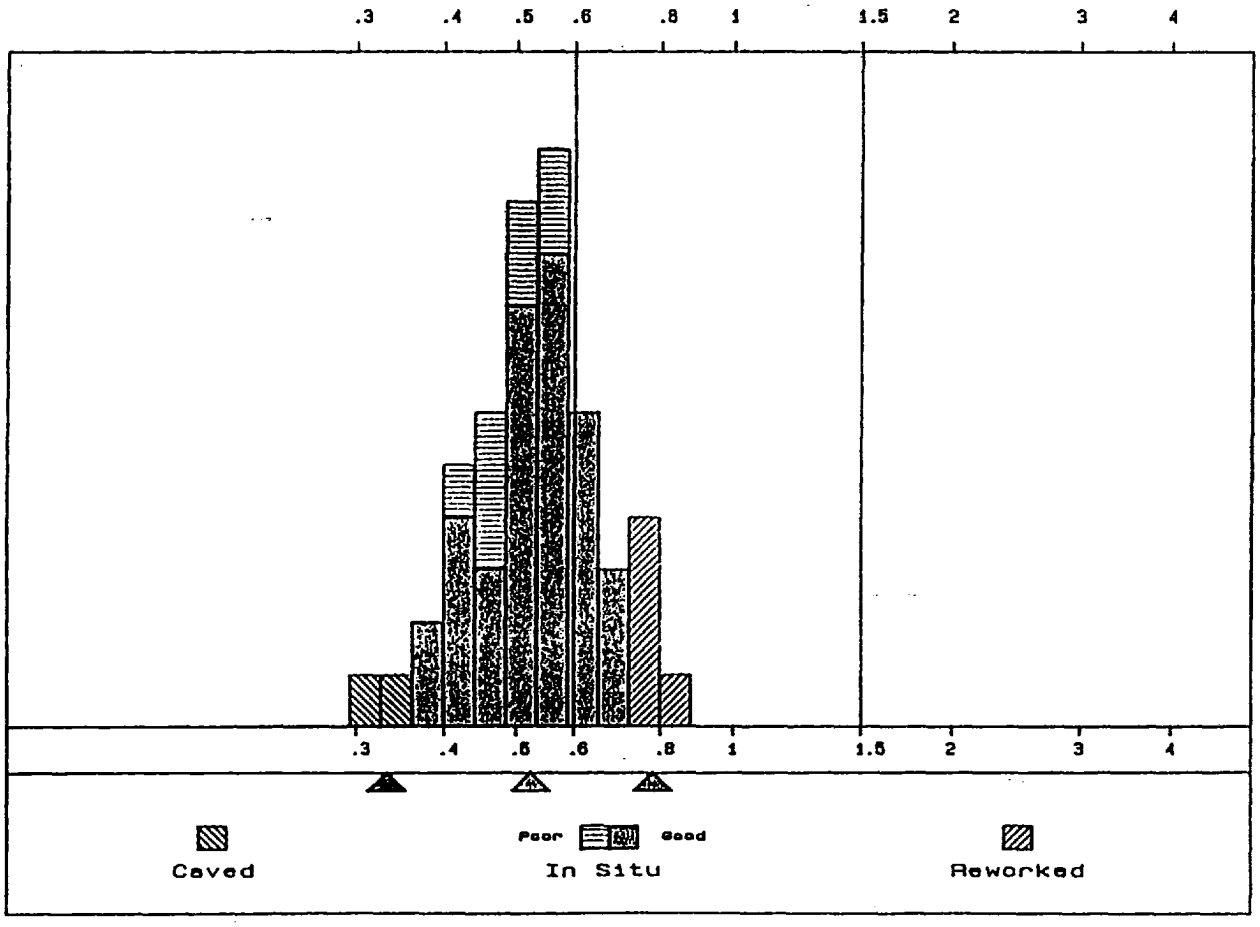


BUJAK DAVIES GROUP : VITRINITE SULLIVAN #2

SAMPLE : 3600f

Population	Mean	Standard Deviation
In Situ	0.52	0.08
Caved	0.33	0.01
Reworked	0.76	0.05
Total	0.54	0.11

Total measurements this sample : 50

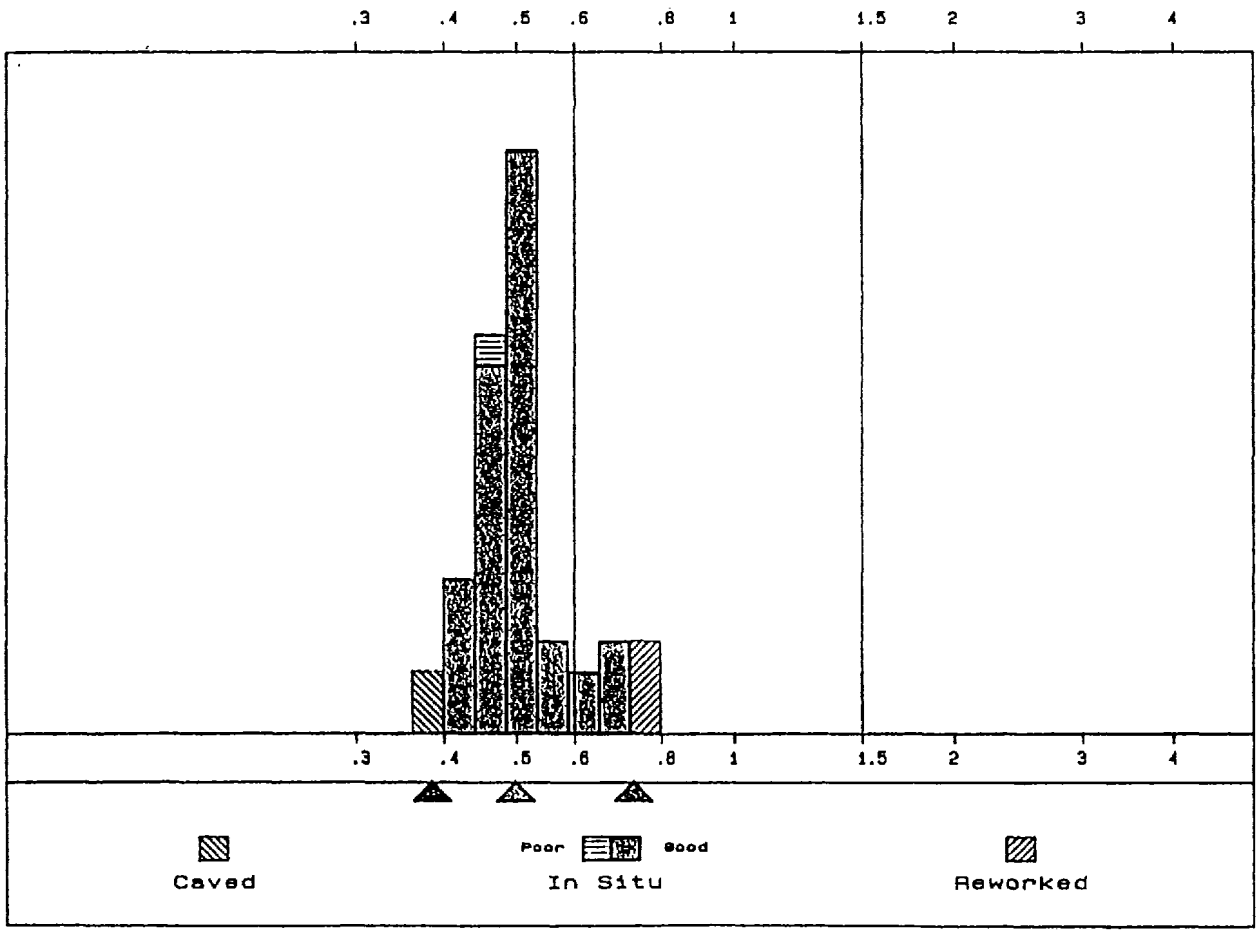


BUJAK DAVIES GROUP : VITRINITE SULLIVAN #2

SAMPLE : 4240f

Population	Mean	Standard Deviation
In Situ	0.49	0.06
Caved	0.38	0.01
Reworked	0.72	0.00
Total	0.50	0.08

Total measurements this sample : 50

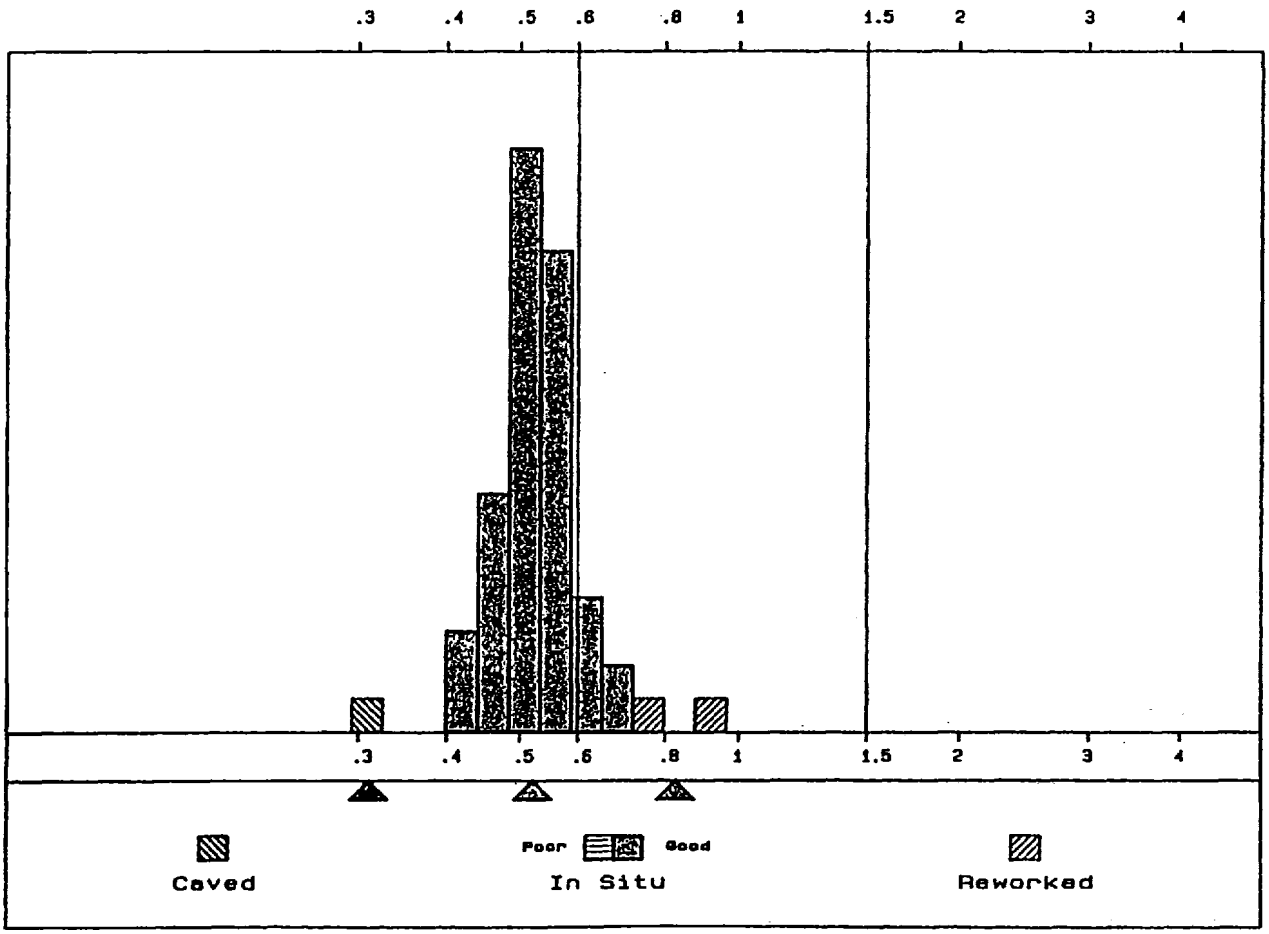


BUJAK DAVIES GROUP : VITRINITE SULLIVAN #2

SAMPLE : 4700f

Population	Mean	Standard Deviation
In Situ	0.52	0.06
Caved	0.31	-
Reworked	0.81	0.07
Total	0.52	0.09

Total measurements this sample : 50

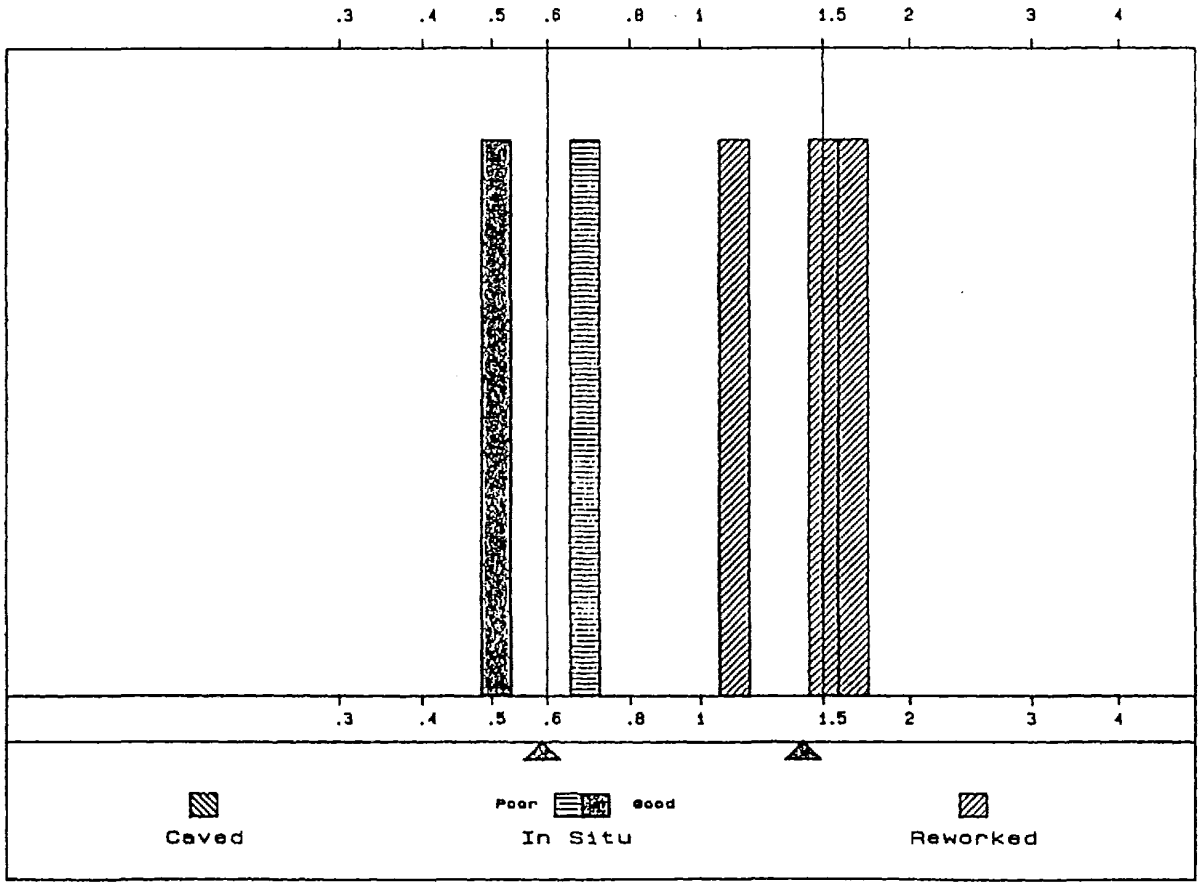


BUJAK DAVIES GROUP : VITRINITE SULLIVAN #2

SAMPLE : 6070f

Population	Mean	Standard Deviation
In Situ	0.59	0.13
Caved	-	-
Reworked	1.38	0.30
Total	1.06	0.49

Total measurements this sample : 5

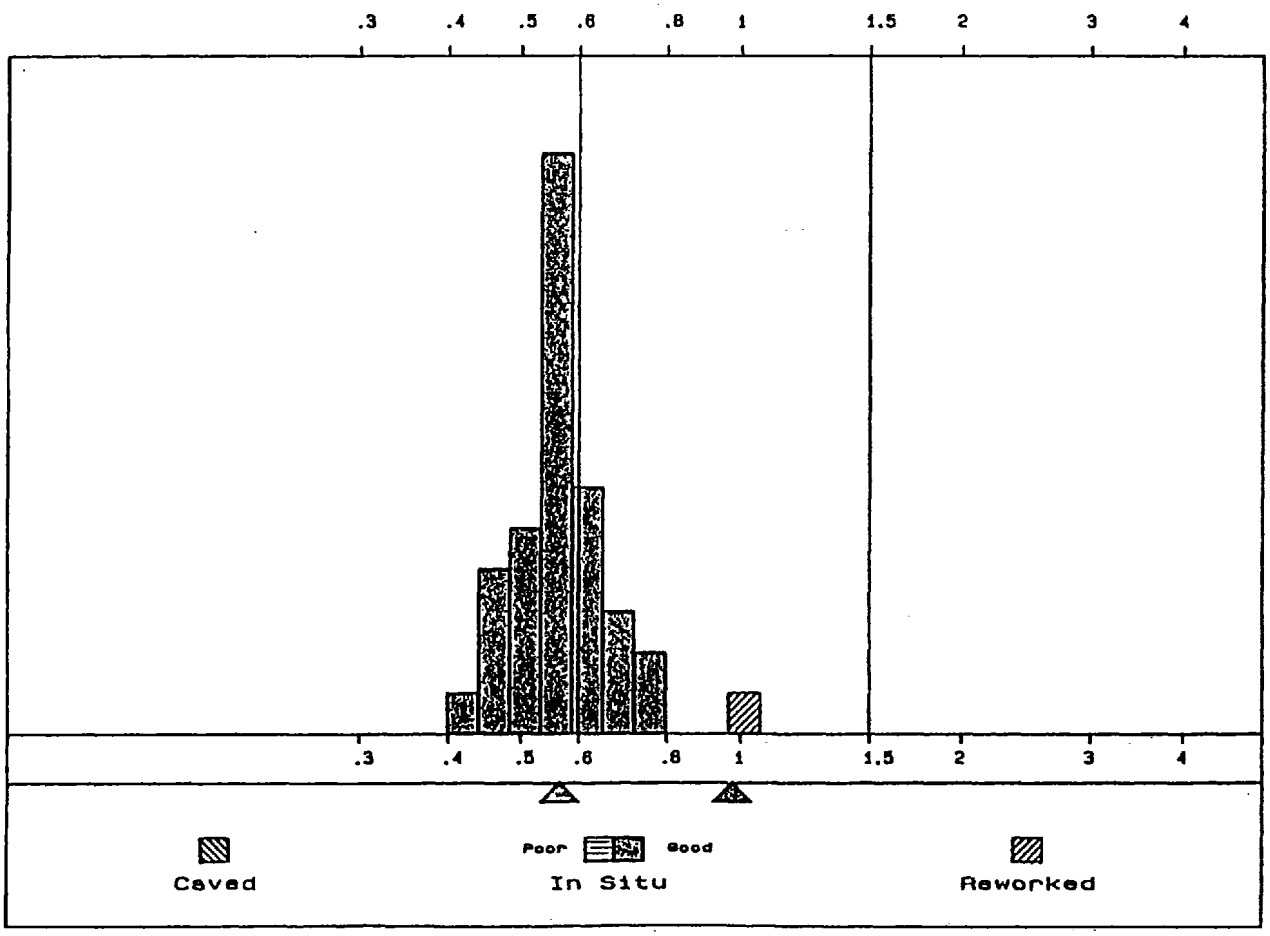


BUJAK DAVIES GROUP : VITRINITE SULLIVAN #2

SAMPLE : 6600f

Population	Mean	Standard Deviation
In Situ	0.56	0.08
Caved	-	-
Reworked	0.96	-
Total	0.57	0.10

Total measurements this sample : 36

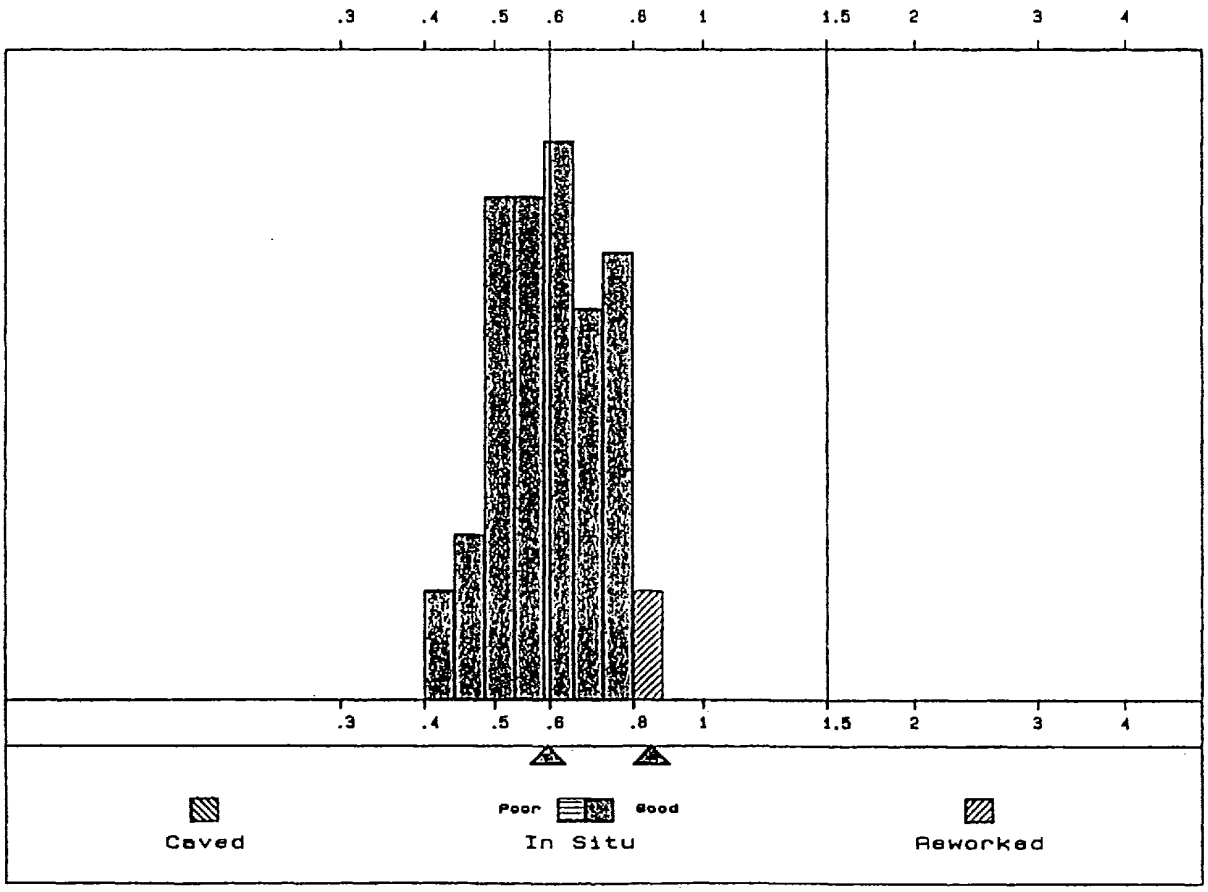


BUJAK DAVIES GROUP : VITRINITE SULLIVAN #2

SAMPLE : 7160f

Population	Mean	Standard Deviation
In Situ	0.59	0.09
Caved	-	-
Reworked	0.83	0.01
Total	0.60	0.10

Total measurements this sample : 50

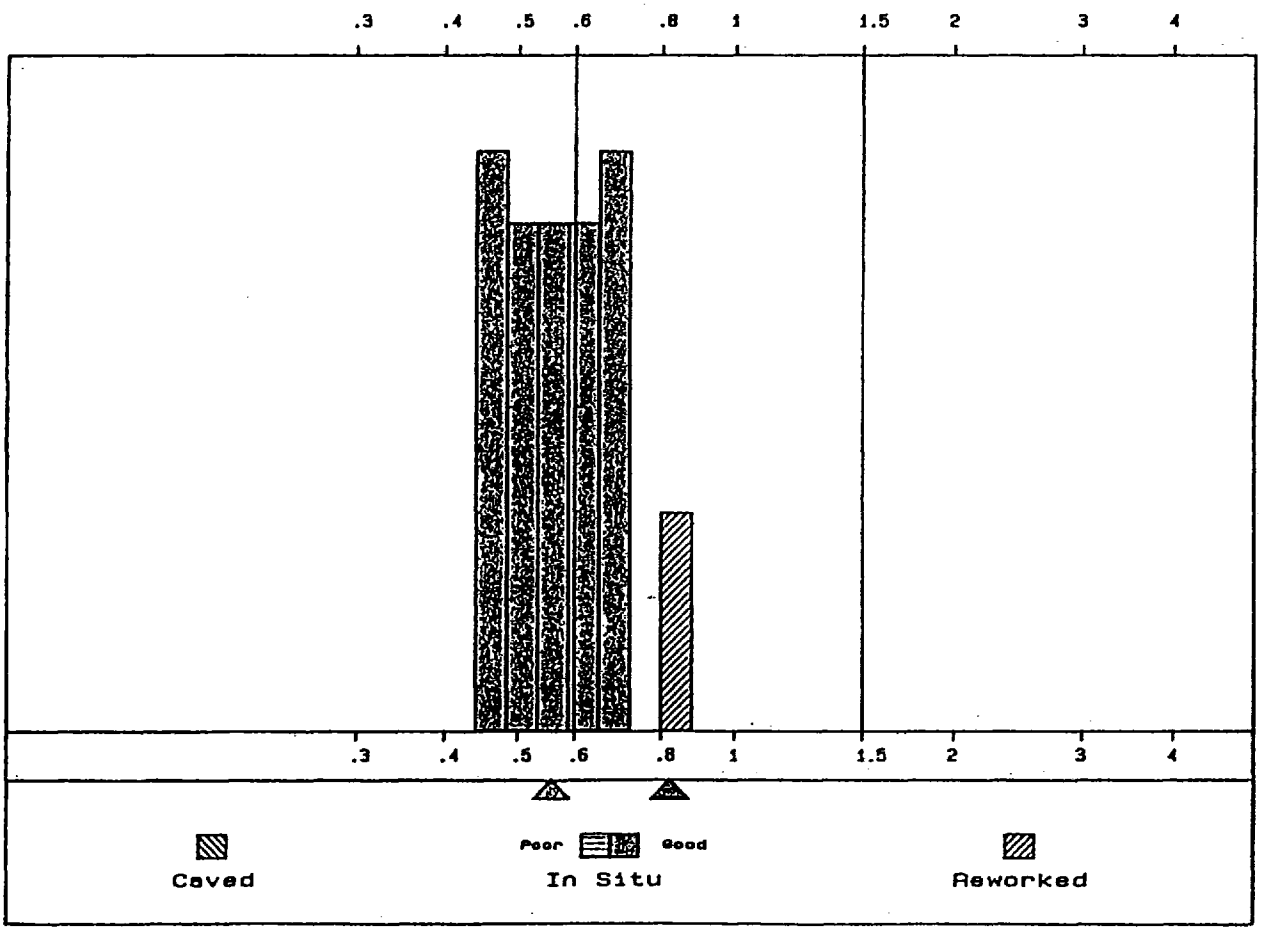


BUJAK DAVIES GROUP : VITRINITE SULLIVAN #2

SAMPLE : 7740f

Population	Mean	Standard Deviation
In Situ	0.55	0.08
Caved	-	-
Reworked	0.80	0.02
Total	0.57	0.10

Total measurements this sample : 40

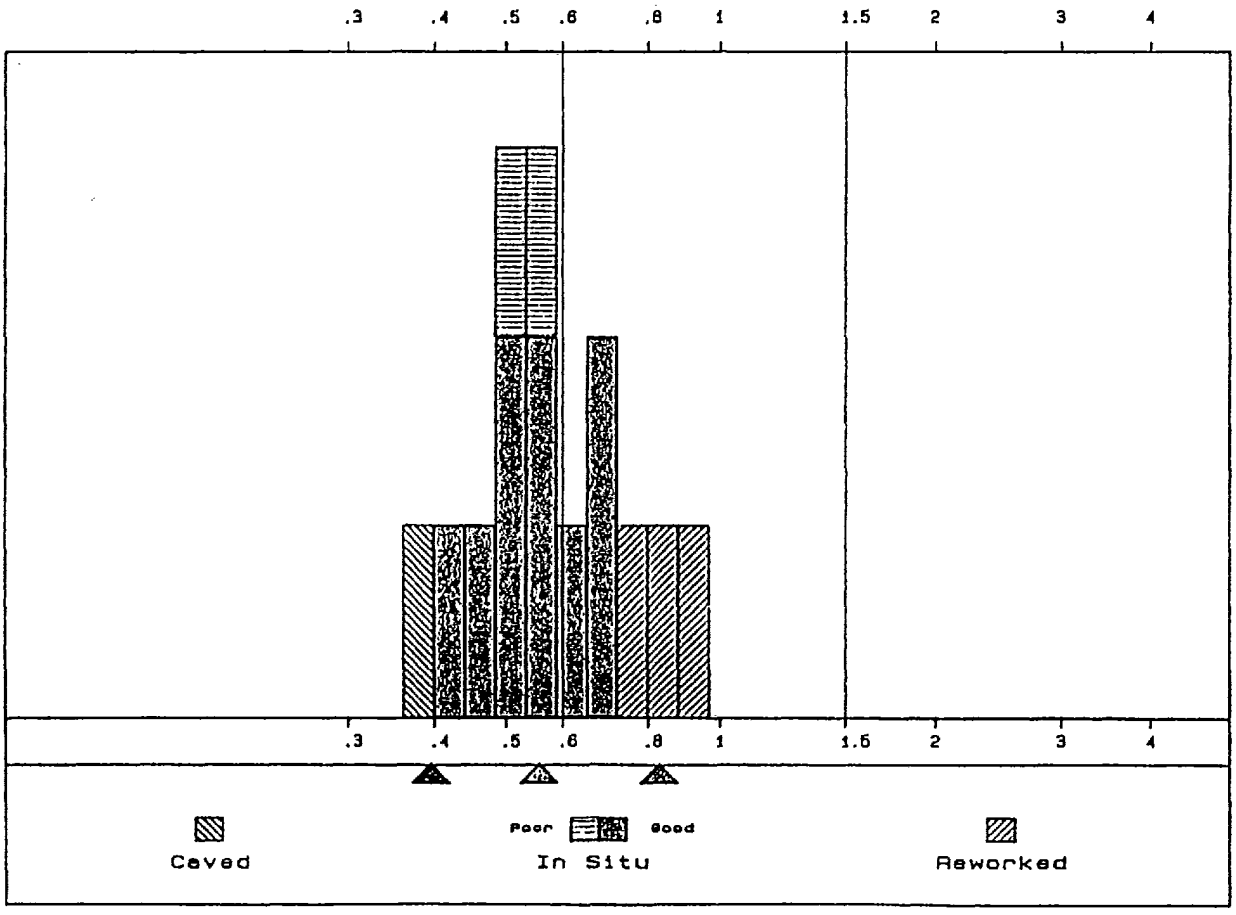


BUJAK DAVIES GROUP : VITRINITE SULLIVAN #2

SAMPLE : 8270f

Population	Mean	Standard Deviation
In Situ	0.55	0.09
Caved	0.39	-
Reworked	0.81	0.09
Total	0.59	0.14

Total measurements this sample : 15

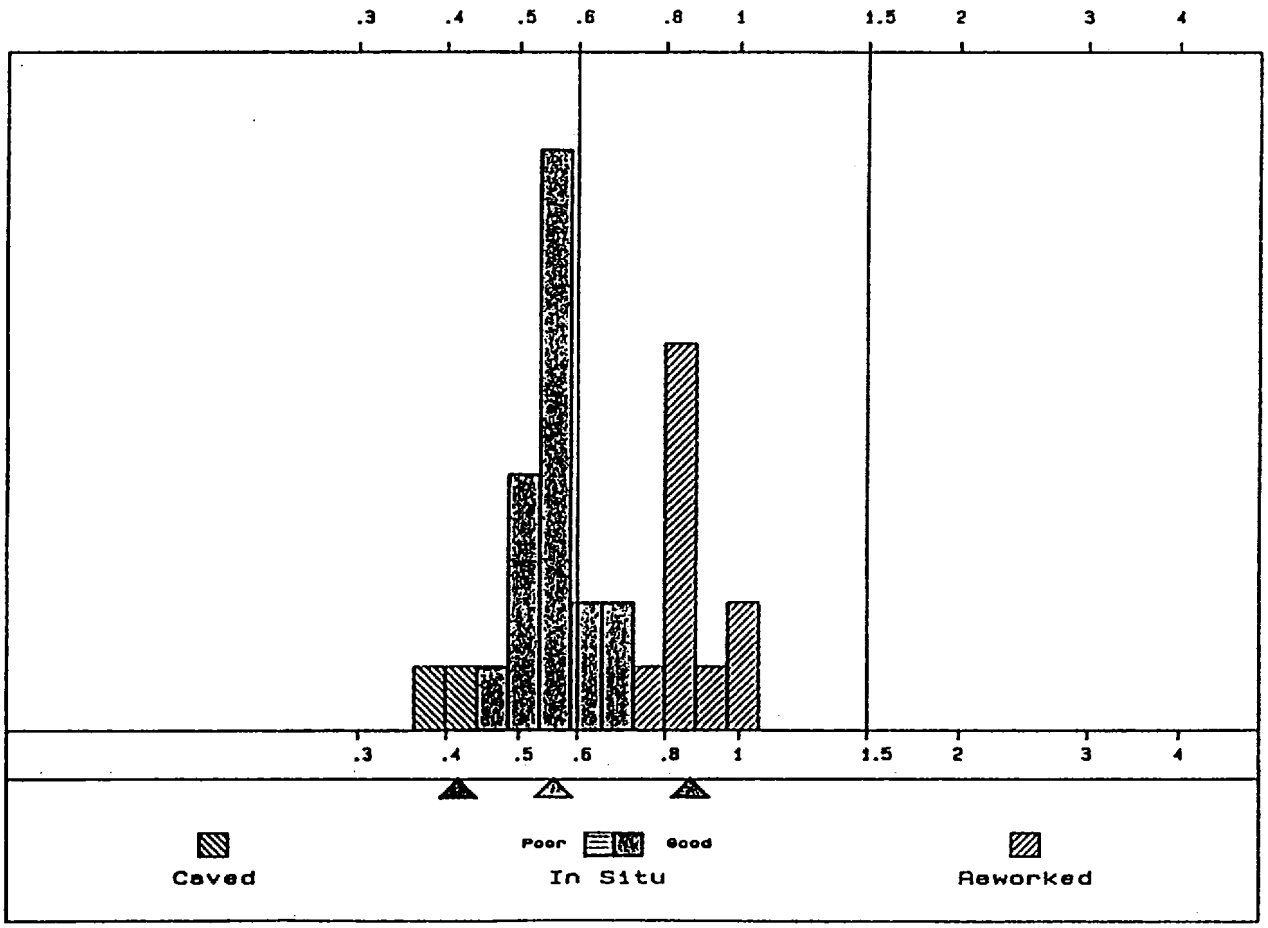


BUJAK DAVIES GROUP : VITRINITE SULLIVAN #2

SAMPLE : 9390f

Population	Mean	Standard Deviation
In Situ	0.65	0.06
Caved	0.41	0.03
Reworked	0.85	0.08
Total	0.64	0.16

Total measurements this sample : 30

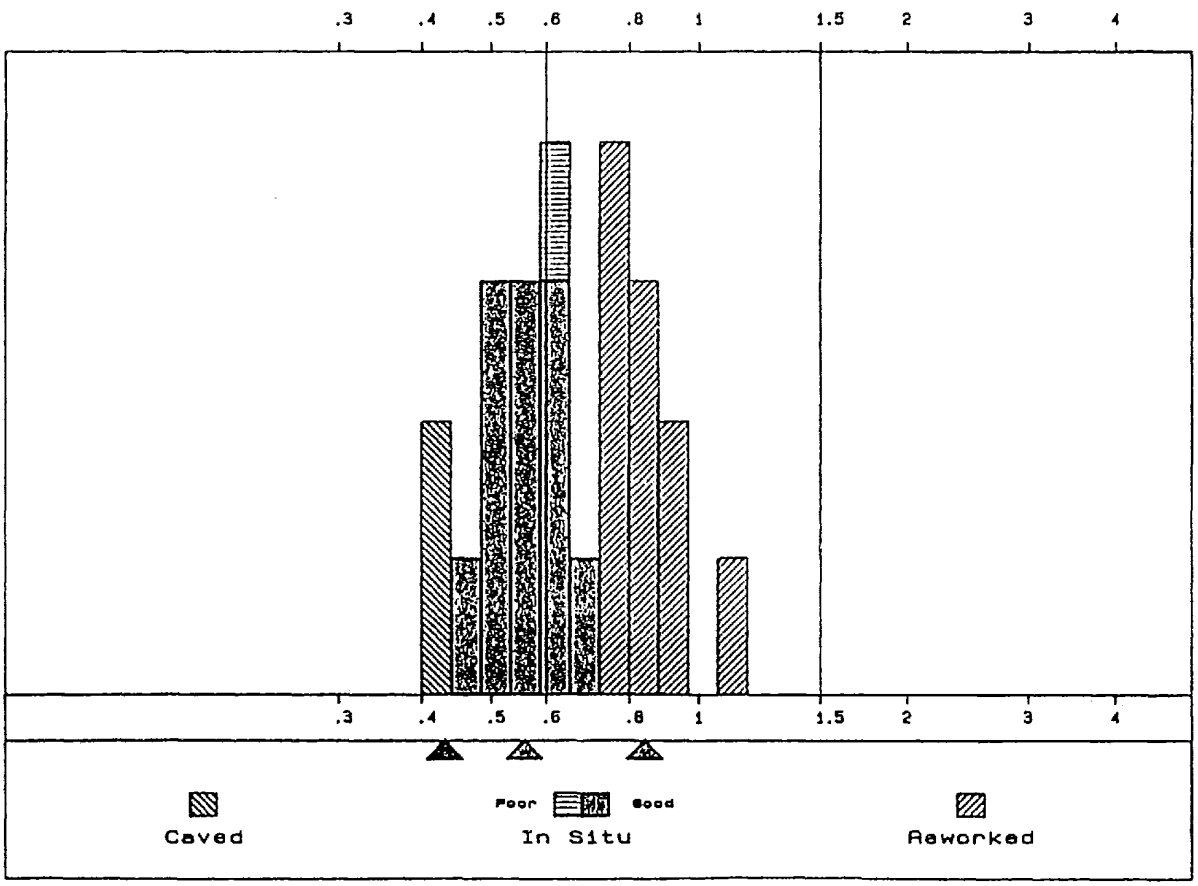


BUJAK DAVIES GROUP : VITRINITE SULLIVAN #2

SAMPLE : 9910f

Population	Mean	Standard Deviation
In Situ	0.55	0.06
Caved	0.43	0.00
Reworked	0.82	0.11
Total	0.66	0.17

Total measurements this sample : 24

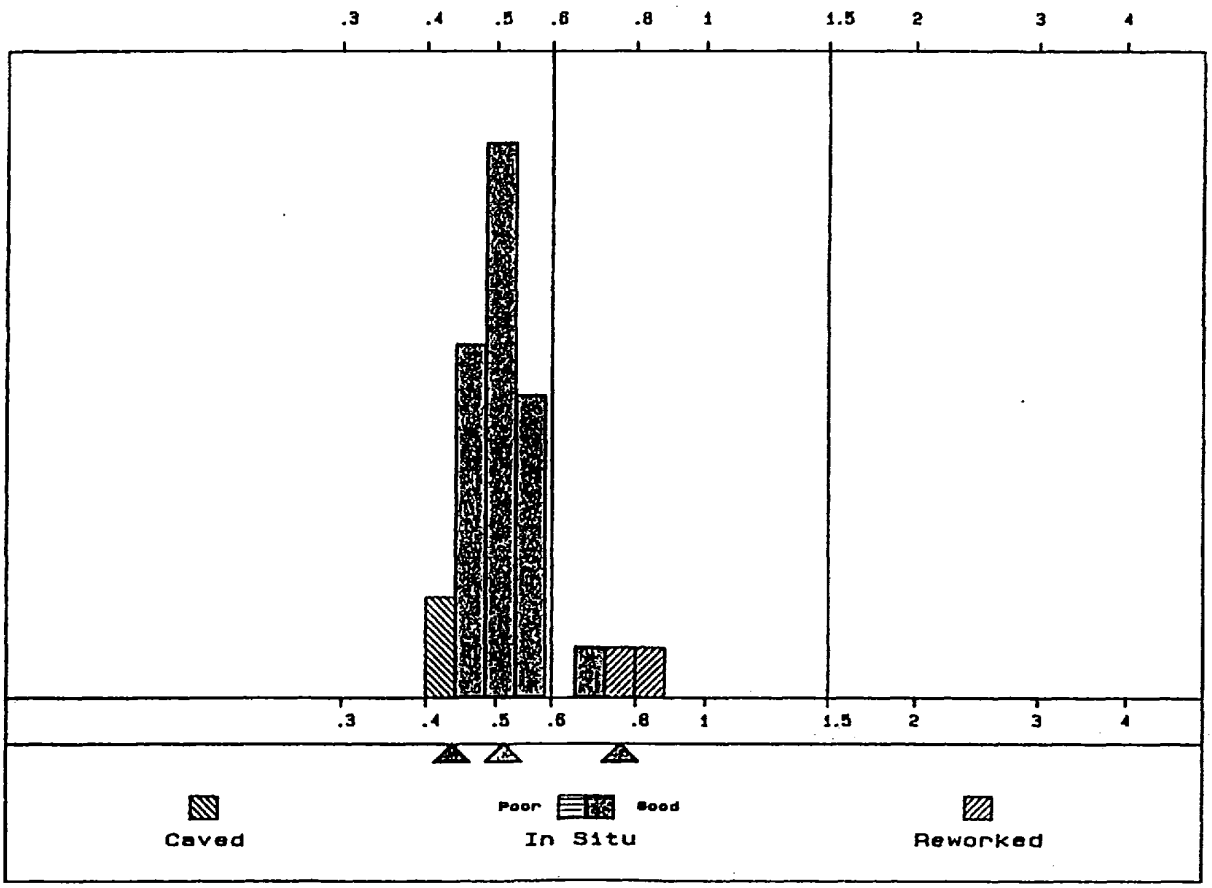


BUJAK DAVIES GROUP : VITRINITE SULLIVAN #2

SAMPLE : 10870f

Population	Mean	Standard Deviation
In Situ	0.51	0.05
Caved	0.43	0.00
Reworked	0.75	0.05
Total	0.52	0.08

Total measurements this sample : 29



BUJAK DAVIES GROUP : VITRINITE SULLIVAN #2

SAMPLE : 11600f

Population	Mean	Standard Deviation
In Situ	0.62	0.05
Caved	0.45	0.04
Reworked	0.81	0.04
Total	0.51	0.11

Total measurements this sample : 35