Vitrinite reflectance data and analysis of the 900 - 13,816 foot interval of the Colorado Oil Malaspina Unit No. 1-A well

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VITRINITE REFLECTANCE ANALYSIS OF THE INTERVAL 900 - 13,816 FT

MALASPINA #1A WELL, ALASKA

Introduction

This report describes the vitrinite reflectance analysis of 15 cuttings samples from the Malaspina #1A 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 unoxidized 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

900-5,760ft	Immature
6,600-12,750ft	Onset of Maturation
13,350-13,823ft	Marginally Mature

Immature Zone: 900-5,760ft

The two uppermost samples in this zone, at 900 and 1,920ft, are entirely reworked. At 3090ft there appears to be several populations of vitrinite on the histogram. The population chosen as in situ has an Ro=0.48%. At 4,200ft and 5,490ft the vitrinite is again almost entirely reworked. One reading from in situ vitrinite in the 5,490ft sample, may suggest that the sample is still in the immature zone (Ro=0.47%); this should not be heavily relied upon.

Onset of Maturation Zone: 6,600-12,750ft

The sample at the top of this zone at 6,600ft contains very little vitrinite. It is again almost entirely reworked. From only two in situ readings, the Ro=0.565%. This may indicate that the sample is in the zone of onset. The 2,880ft sample (Ro=0.534%) is in aggreement with the overlying sample. Other samples deeper in this zone have slightly depressed Ro's and only fair histogram distributions, due to the presence of cavings and reworked material. The 10,560ft, 11,880ft and 12,510ft samples (Ro's=0.501,0.530% and 0.540%, respectively) all have relatively good histogram distributions and can be considered reliable.

Marginally Mature Zone: 13,350-13,823

Both samples in this zone have good histogram distributions, even though they contain a fair amount of pyrite and little vitrinite. From fifty readings, taken on both samples, the Ro's=0.736 and 0.798% indicate that these samples are well within the oil window.

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.
1977 Offshore eastern Canada Part II. Offshore east Canada's organic type and colour and hydrocarbon potential. Oil and Gas Journal vol.75, pp.96-100.

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: MALASPINA#1A
Area: ALASKA

Scientist: DUMCIUS
Date: JULY 1988
Samples are: F

VITRINITE DATA:
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Sample Depth : 900.0

0.700	R	0.830	R	0.830	R	0.850	R	0.860	R	0.860	R	0.870	R
0.880	R	0.890	R	0.900	R	0.900	R	0.910	R	0.910	R	0.910	R
0.910	R	0.910	R	0.920	R	0.930	R	0.930	R	0.940	R	0.950	R
0.960	R	0.960	R	0.960	R	0.980	R	0.990	R	1.000	R	1.030	R
1.040	R	1.040	R	1.050	R	1.050	R	1.060	R	1.060	R	1.060	R
1.110	R	1.130	R	1.140	R	1.140	R	1.170	R	1.170	R	1.180	R
1.260	R	1.260	R	1.320	R	1.360	R	1.370	R	1.430	R	1.900	R
1.980	R												

Actual Mean = 1.055 Actual Standard Deviation = 0.240

Comment : Mostly fine light grey amorphous inorganic material; little vitrinite present.

Sample Depth : 1920.0

0.650	R	0.680	R	0.690	R	0.710	R	0.720	R	0.730	R	0.840	R
0.880	R	0.890	R	0.900	R	0.920	R	0.930	R	0.950	R	0.950	R
0.960	R	0.990	R	1.000	R	1.000	R	1.010	R	1.040	R	1.070	R
1.140	R	1.150	R	1.210	R	1.250	R	1.260	R	1.290	R	1.290	R
1.300	R	1.330	R	1.330	R	1.330	R	1.330	R	1.380	R	1.400	R
1.440	R	1.450	R	1.470	R	1.490	R	1.550	R	1.570	R	1.590	R
1.660	R	1.790	R	1.790	R	1.810	R	2.030	R	2.120	R	2.140	R
2.240	R												

Actual Mean = 1.253 Actual Standard Deviation = 0.404

Comment : Mostly fine light grey amorphous inorganic material; little vitrinite present.

Sample Depth : 3090.0

0.290	C	0.390		0.400		0.430		0.430		0.450		0.460	
0.460		0.480		0.520		0.540		0.550		0.560		0.570	
0.610	R	0.650	R	0.710	R	0.710	R	0.740	R	0.780	R	0.790	R
0.800	R	0.820	R	0.950	R	0.990	R	1.070	R	1.100	R	1.100	R
1.180	R	1.200	R	1.290	R	1.360	R	1.370	R	1.380	R	1.420	R
1.450	R	1.450	R	1.490	R	1.560	R	1.610	R	1.650	R	1.860	R

Actual Mean = 0.920 Actual Standard Deviation = 0.434

Edited Mean = 0.480 Edited Standard Deviation = 0.062

Comment : Mostly fine light grey amorphous inorganic material; little vitrinite present.

Sample Depth : 4200.0

0.600	R	0.640	R	0.680	R	0.680	R	0.680	R	0.680	R	0.700	R
0.720	R	0.770	R	0.770	R	0.780	R	0.780	R	0.790	R	0.790	R
0.800	R	0.840	R	0.850	R	0.860	R	0.880	R	0.900	R	0.900	R
0.910	R	0.910	R	0.920	R	0.950	R	0.950	R	0.960	R	0.960	R
0.970	R	0.980	R	0.990	R	1.000	R	1.020	R	1.020	R	1.020	R
1.030	R	1.060	R	1.150	R	1.160	R	1.160	R	1.280	R	1.290	R
1.300	R	1.320	R	1.360	R	1.380	R	1.500	R	1.510	R	1.560	R
1.610	R												

Actual Mean = 0.986 Actual Standard Deviation = 0.257

Comment : Mostly fine light grey amorphous inorganic material; little vitrinite present.

Sample Depth : 5490.0

0.470		0.740	R	0.750	R	0.810	R	0.830	R	0.940	R	1.030	R
1.100	R	1.200	R	1.240	R	1.240	R	1.340	R	1.380	R	1.390	R
1.420	R												

Actual Mean = 1.059 Actual Standard Deviation = 0.291

Edited Mean = 0.470 Edited Standard Deviation = 0.000

Comment : Almost entirely fine light grey amorphous inorganic material; very little vitrinite present.

Sample Depth : 6600.0

0.530		0.600		0.670	R	0.670	R	0.720	R	0.720	R	0.740	R
0.950	R	0.990	R										

Actual Mean = 0.732 Actual Standard Deviation = 0.150

Edited Mean = 0.565 Edited Standard Deviation = 0.049

Comment : Almost entirely fine light grey amorphous inorganic material; very little vitrinite present.

Sample Depth : 8280.0

0.260	C	0.260	C	0.270	C	0.310	C	0.320	C	0.330	C	0.330	C
0.340	C	0.370	C	0.390	C	0.390	C	0.390	C	0.410	C	0.410	C
0.420	C	0.430	C	0.430	C	0.430	C	0.440		0.450		0.480	
0.480	P	0.480		0.490		0.490		0.490		0.500		0.510	
0.510		0.510		0.520		0.530		0.540		0.540		0.550	
0.550		0.560	P	0.570		0.570		0.580		0.590		0.590	
0.600		0.600		0.600		0.620		0.700	R	0.760	R	0.770	R
0.790	R												

Actual Mean = 0.489 Actual Standard Deviation = 0.125

Edited Mean = 0.534 Edited Standard Deviation = 0.050

Comment : Little vitrinite present.

Sample Depth : 9090.0

0.290	C	0.320	C	0.330	C	0.340	C	0.350	C	0.350	C	0.350	C
0.350	C	0.350	C	0.350	C	0.360	C	0.360	C	0.360	C	0.360	C
0.380	C	0.380	C	0.380	C	0.390	C	0.390	C	0.400	C	0.410	C
0.410	C	0.410	C	0.410	C	0.420	C	0.420	C	0.420	C	0.430	C
0.430	C	0.440		0.450		0.450		0.450		0.450		0.480	
0.480		0.490		0.490		0.490		0.500		0.540		0.550	
0.560		0.580		0.590		0.600		0.660	R	0.660	R	0.740	R
1.290	R												

Actual Mean = 0.457 Actual Standard Deviation = 0.155

Edited Mean = 0.505 Edited Standard Deviation = 0.054

Comment : Mostly small, occasionally large vitrinite particles present.

Sample Depth : 9810.0

0.400	C	0.430	C	0.450		0.460		0.480		0.500		0.500	
0.510	E	0.520		0.520		0.560		0.600		0.630		0.630	
0.670	R	0.680	R	0.690	R	0.710	R	0.710	R	0.710	R	0.710	R
0.720	R	0.720	R	0.730	R	0.760	R	0.770	R	0.770	R	0.790	R
0.790	R	0.810	R	0.830	R	0.830	R	0.830	R	0.830	R	0.840	R
0.850	R	0.880	R	0.880	R	0.890	R	0.900	R	0.910	R	0.930	R
1.010	R	1.020	R	1.040	R	1.050	R	1.059	R	1.130	R	1.240	R
1.400	R												

Actual Mean = 0.766 Actual Standard Deviation = 0.215

Edited Mean = 0.530 Edited Standard Deviation = 0.062

Comment : Mostly small particles present.

Sample Depth : 10560.0

0.390	C	0.410	C	0.420	C	0.430	C	0.430	C	0.430	C	0.440	
0.440		0.440		0.450		0.450		0.460		0.460		0.460	
0.460		0.460		0.470		0.480		0.480		0.480		0.490	
0.500		0.500		0.500		0.500		0.500		0.510		0.510	P
0.510		0.520		0.520		0.520		0.530		0.540		0.560	
0.560		0.560		0.570		0.580		0.610		0.650	R	0.650	R
0.670	R	0.670	R	0.710	R	0.730	R	0.770	R	0.780	R	0.870	R
0.880	R												

Actual Mean = 0.538 Actual Standard Deviation = 0.116

Edited Mean = 0.501 Edited Standard Deviation = 0.044

Comment : Occasionally large, mostly small vitrinite particles present.

Sample Depth : 11160.0

0.370	C	0.380	C	0.390	C	0.410	C	0.410	C	0.430	C	0.440	
0.440		0.440		0.450		0.470		0.480		0.500		0.510	
0.510		0.520		0.520		0.520		0.530		0.530		0.550	
0.560		0.560		0.590		0.590		0.590		0.600		0.620	
0.710	R	0.730	R	0.800	R	0.810	R	0.820	R	0.840	R	0.850	R

Actual Mean = 0.556 Actual Standard Deviation = 0.139

Edited Mean = 0.524 Edited Standard Deviation = 0.055

Comment : Little vitrinite present.

Sample Depth : 11880.0

0.320	C	0.380	C	0.400	C	0.400	C	0.420	C	0.420	C	0.430	C
0.440	P	0.440		0.480		0.490		0.490		0.500		0.500	
0.510		0.520		0.520		0.520		0.530		0.530		0.530	
0.540		0.540		0.570		0.580		0.580		0.580		0.590	
0.680		0.720	R	0.720	R	0.740	R	0.760	R	0.780	R	0.800	R
0.810	R	0.810	R	0.830	R	0.840	R	0.840	R	0.880	R	0.880	R
0.950	R	1.040	R	1.120	R								

Actual Mean = 0.621 Actual Standard Deviation = 0.190

Edited Mean = 0.530 Edited Standard Deviation = 0.053

Comment : Little vitrinite present.

Sample Depth : 12510.0

0.400	C	0.410	C	0.440		0.440		0.460		0.470		0.480	
0.490		0.490		0.490		0.500		0.500		0.500		0.510	
0.520		0.520		0.520		0.530		0.540		0.540		0.550	
0.550		0.550		0.560		0.570		0.570		0.580		0.580	
0.590		0.600		0.600		0.620		0.620		0.620		0.630	
0.640		0.750	R	0.810	R	0.810	R	0.830	R	0.840	R	0.840	R
0.870	R	0.890	R	0.900	R	0.930	R	0.980	R	1.190	R	1.210	R
1.210	R												

Actual Mean = 0.645 Actual Standard Deviation = 0.206

Edited Mean = 0.540 Edited Standard Deviation = 0.056

Comment : Little vitrinite present.

Sample Depth : 13350.0

0.420	C	0.600		0.620		0.620		0.630	P	0.630		0.630	
0.640		0.650		0.660		0.660		0.660		0.660		0.660	
0.680		0.680		0.690		0.700		0.700		0.710		0.720	
0.720		0.720		0.720		0.720		0.730		0.730	P	0.740	
0.740	P	0.750		0.750		0.760		0.760		0.760		0.760	
0.770		0.780		0.780	P	0.790		0.790		0.800	P	0.810	
0.820		0.830		0.830	P	0.830		0.830		0.840		0.870	
0.880													

Actual Mean = 0.725 Actual Standard Deviation = 0.084

Edited Mean = 0.731 Edited Standard Deviation = 0.072

Comment : Common pyrite; abundant degraded amorphous material; little vitrinite present.

Sample Depth : 13816.0

0.580	C	0.600		0.640		0.660		0.690		0.700		0.710	
0.710		0.720		0.720		0.720		0.730		0.730		0.730	
0.730		0.740		0.750		0.760		0.770		0.770		0.770	
0.770		0.790		0.790		0.790		0.790		0.790		0.790	
0.820		0.820		0.830		0.830		0.840		0.840		0.860	
0.880		0.890		0.920		0.930		0.940		0.940		0.950	
0.960		1.000		1.019		1.110	R	1.120	R	1.159	R	1.210	R
1.260	R												

Actual Mean = 0.831 Actual Standard Deviation = 0.151

Edited Mean = 0.798 Edited Standard Deviation = 0.097

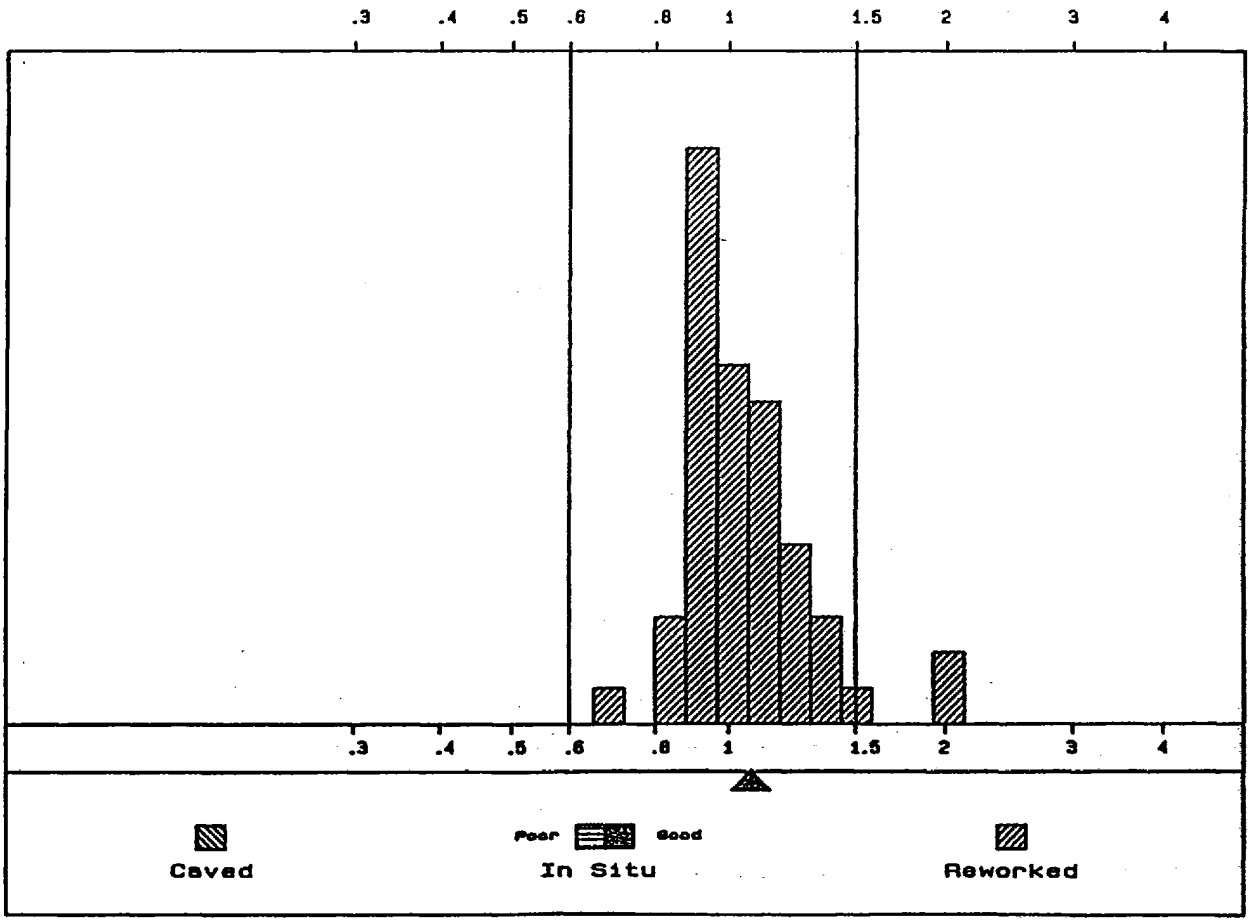
Comment : Common pyrite; abundant degraded amorphous material; little vitrinite present.

BUJAK DAVIES GROUP : VITRINITE MALASPINA#1A

SAMPLE : 900f

Population	Mean	Standard Deviation
In Situ	-	-
Caved	-	-
Reworked	1.05	0.24
Total	1.05	0.24

Total measurements this sample : 50

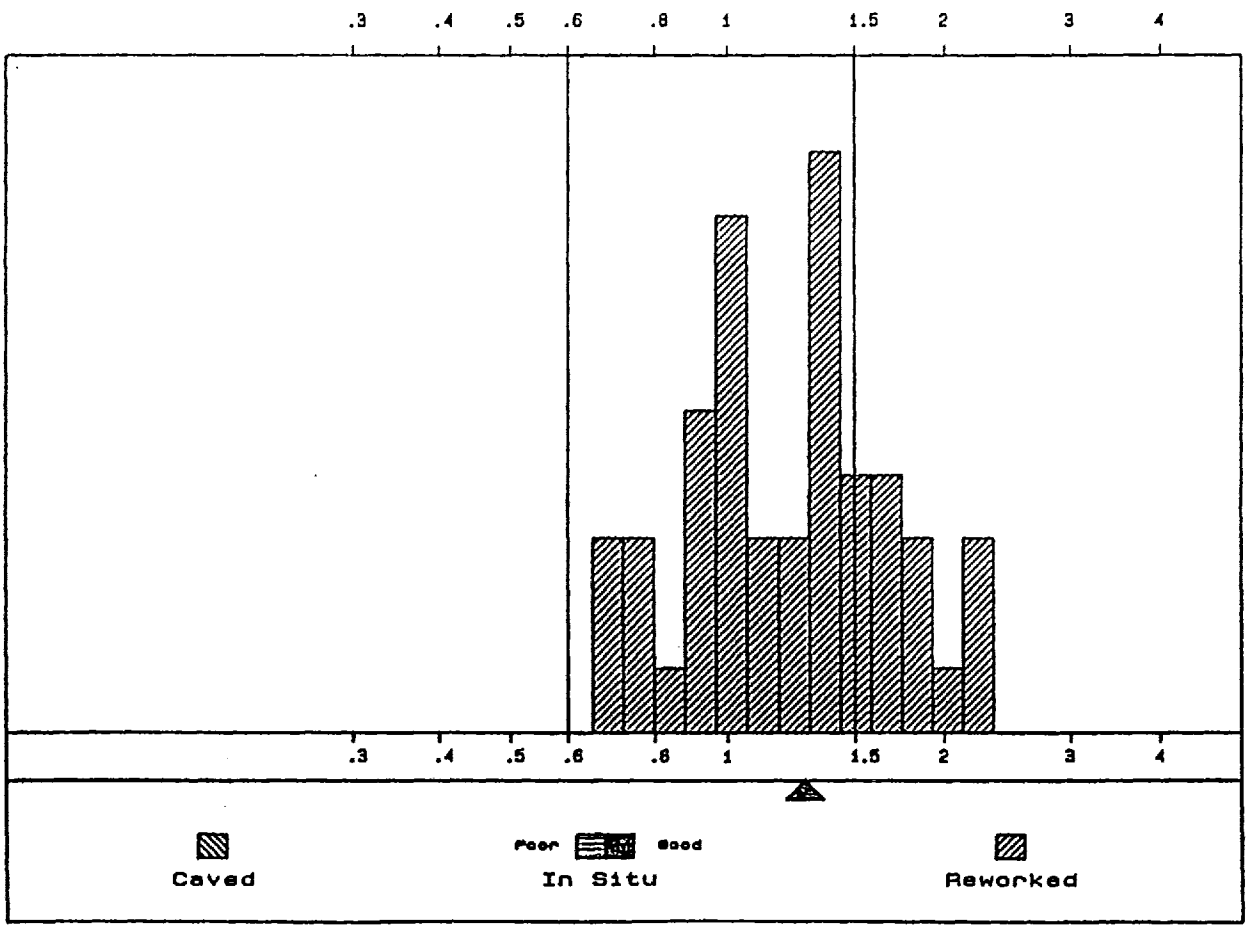


BUJAK DAVIES GROUP : VITRINITE MALASPINA#1A

SAMPLE : 1920f

Population	Mean	Standard Deviation
In Situ	-	-
Caved	-	-
Reworked	1.25	0.40
Total	1.25	0.40

Total measurements this sample : 50

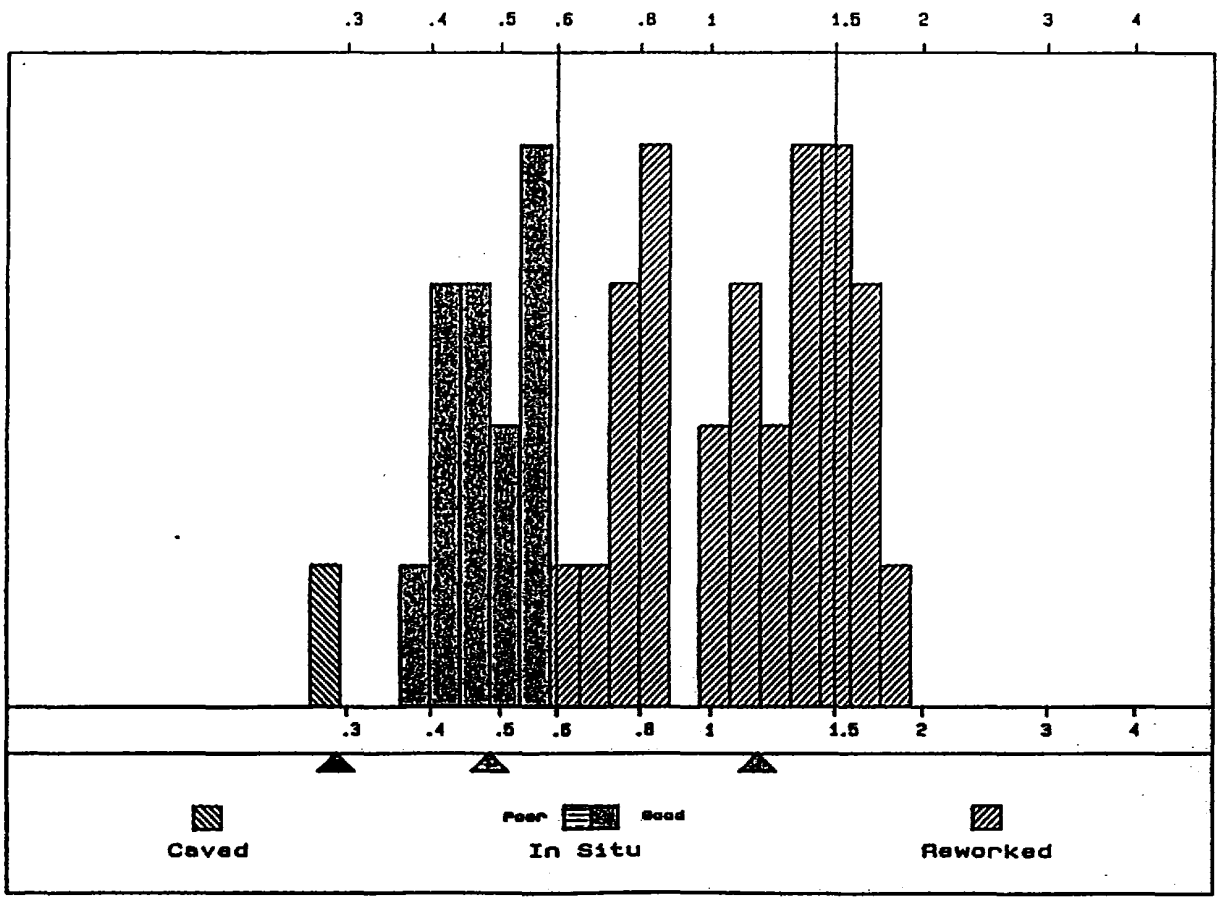


BUJAK DAVIES GROUP : VITRINITE MALASPINA#1A

SAMPLE : 3090f

Population	Mean	Standard Deviation
In Situ	0.48	0.06
Caved	0.29	-
Reworked	1.15	0.35
Total	0.92	0.43

Total measurements this sample : 42

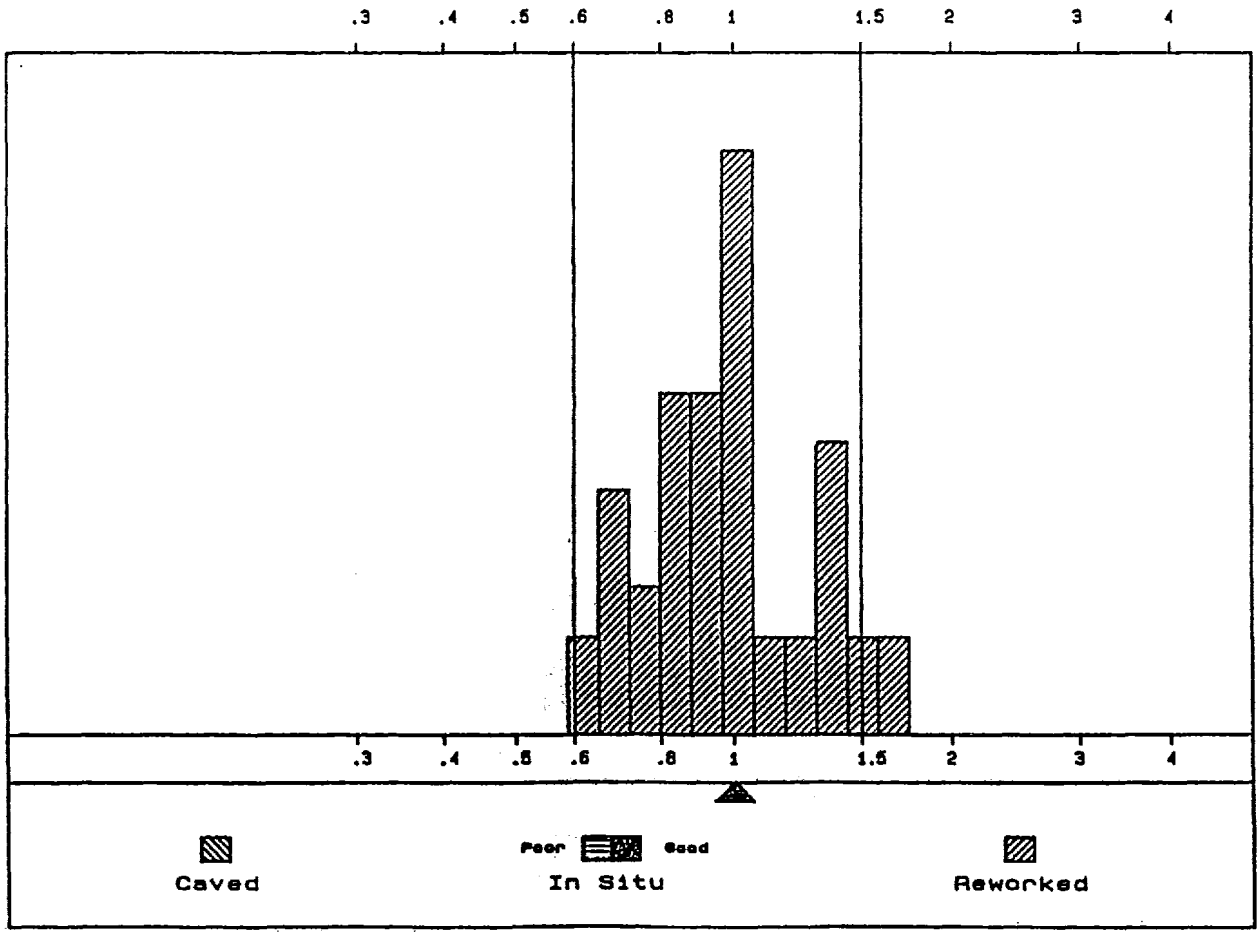


BUJAK DAVIES GROUP : VITRINITE MALASPINA#1A

SAMPLE : 4200f

Population	Mean	Standard Deviation
In Situ	-	-
Caved	-	-
Reworked	0.99	0.26
Total	0.99	0.26

Total measurements this sample : 50

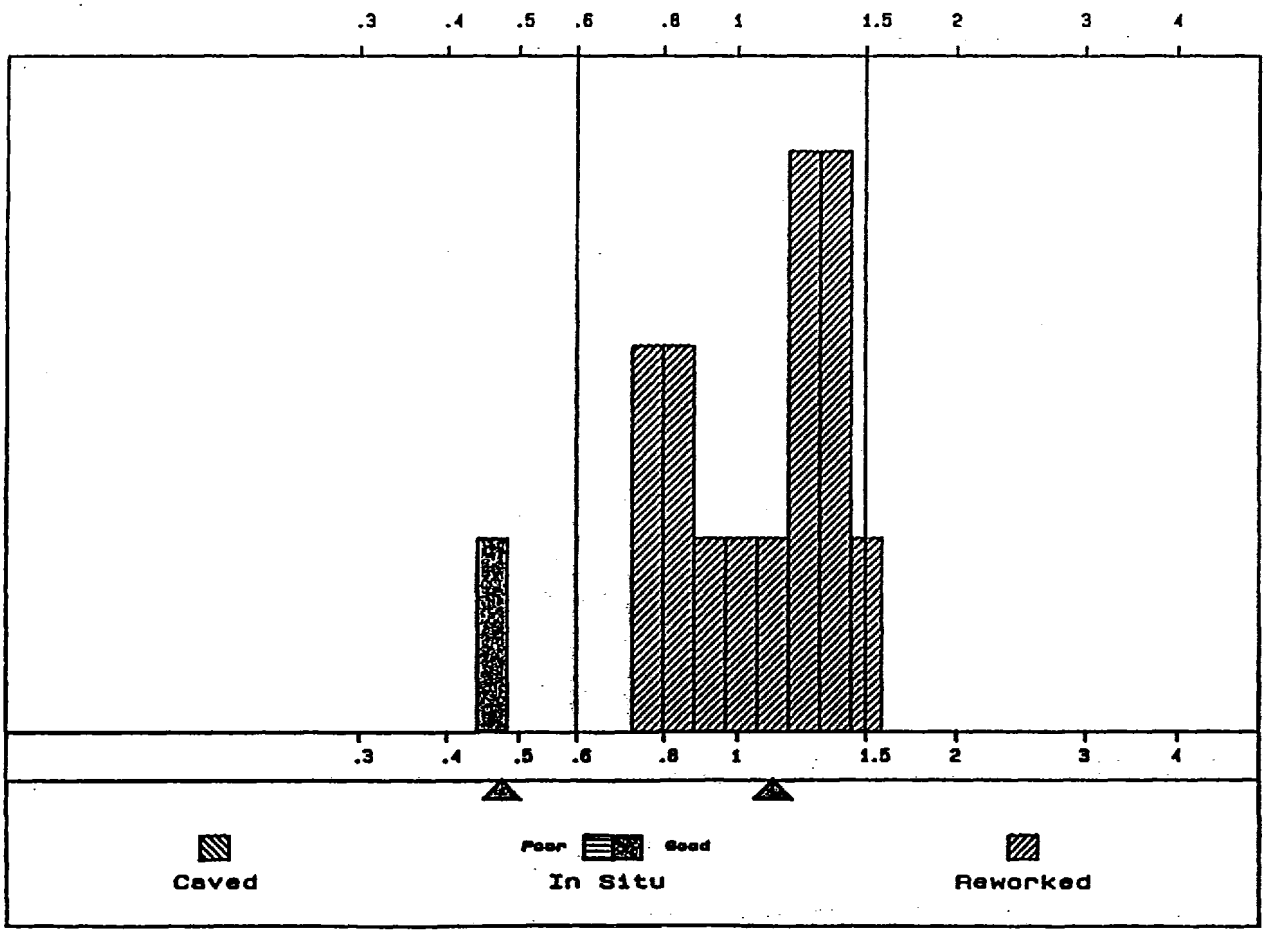


BUJAK DAVIES GROUP : VITRINITE MALASPINA#1A

SAMPLE : 5490f

Population	Mean	Standard Deviation
In Situ	0.47	-
Caved	-	-
Reworked	1.10	0.25
Total	1.06	0.29

Total measurements this sample : 15

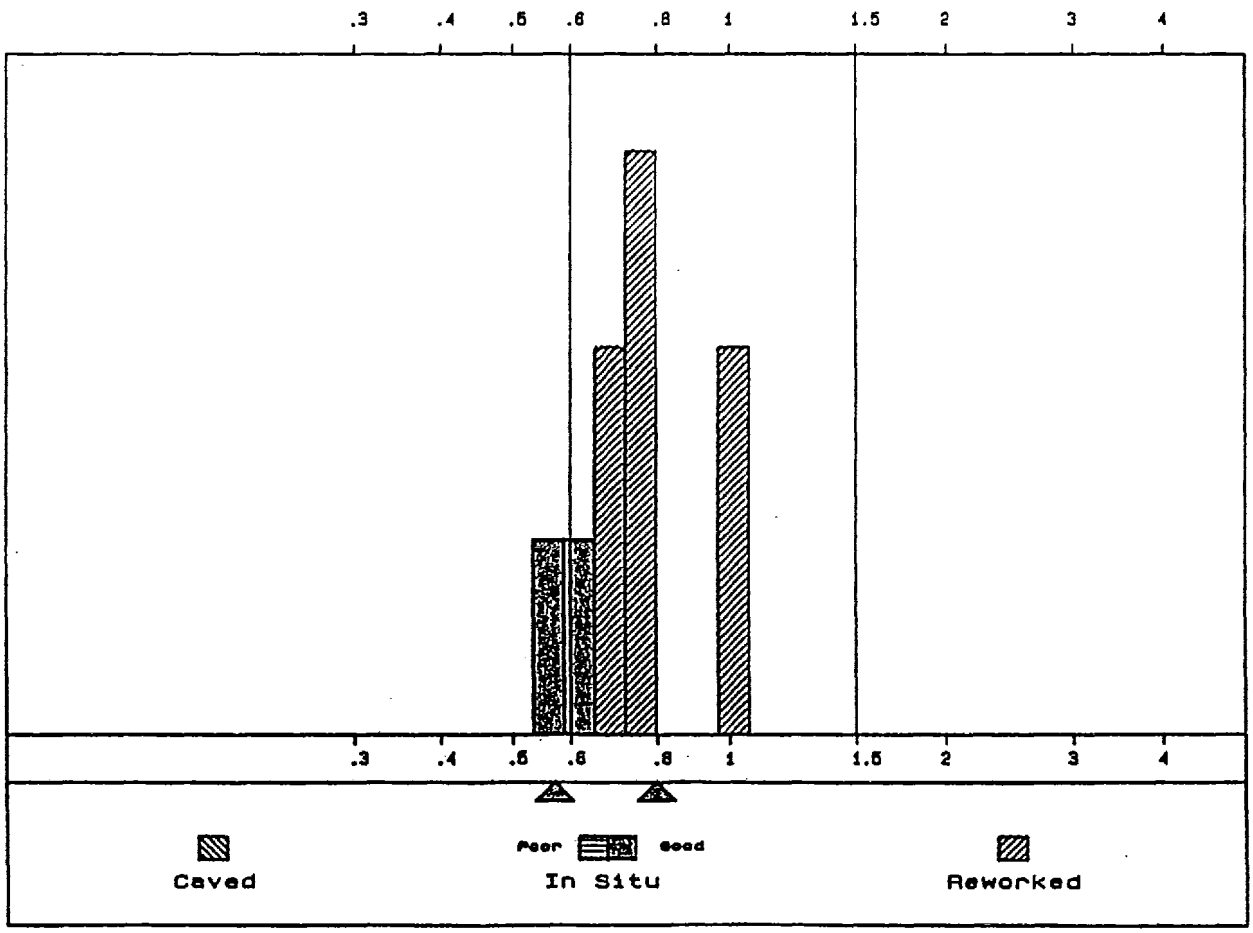


BUJAK DAVIES GROUP : VITRINITE MALASPINA#1A

SAMPLE : 6600f

Population	Mean	Standard Deviation
In Situ	0.56	0.05
Caved	-	-
Reworked	0.78	0.13
Total	0.73	0.15

Total measurements this sample : 9

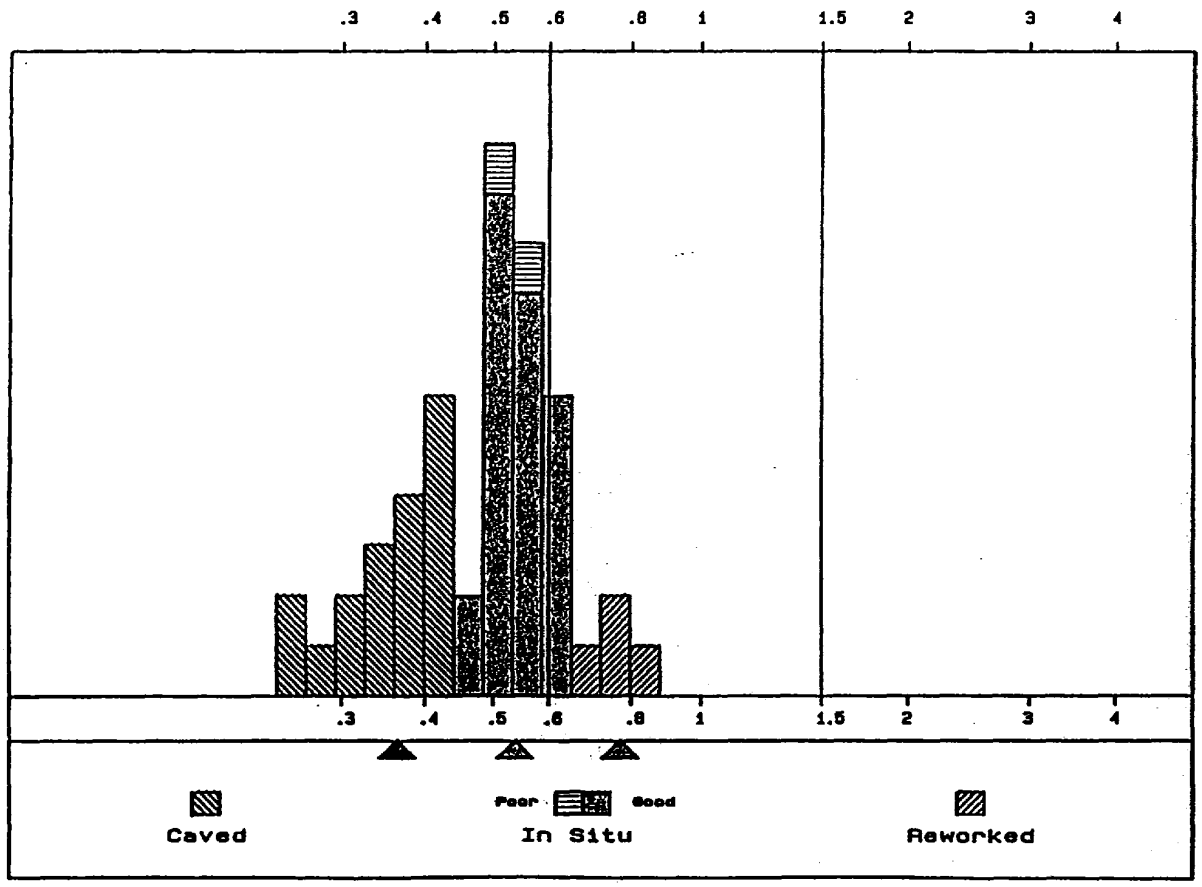


BUJAK DAVIES GROUP : VITRINITE MALASPINA#1A

SAMPLE : 8280f

Population	Mean	Standard Deviation
In Situ	0.53	0.05
Caved	0.36	0.06
Reworked	0.76	0.04
Total	0.49	0.13

Total measurements this sample : 50

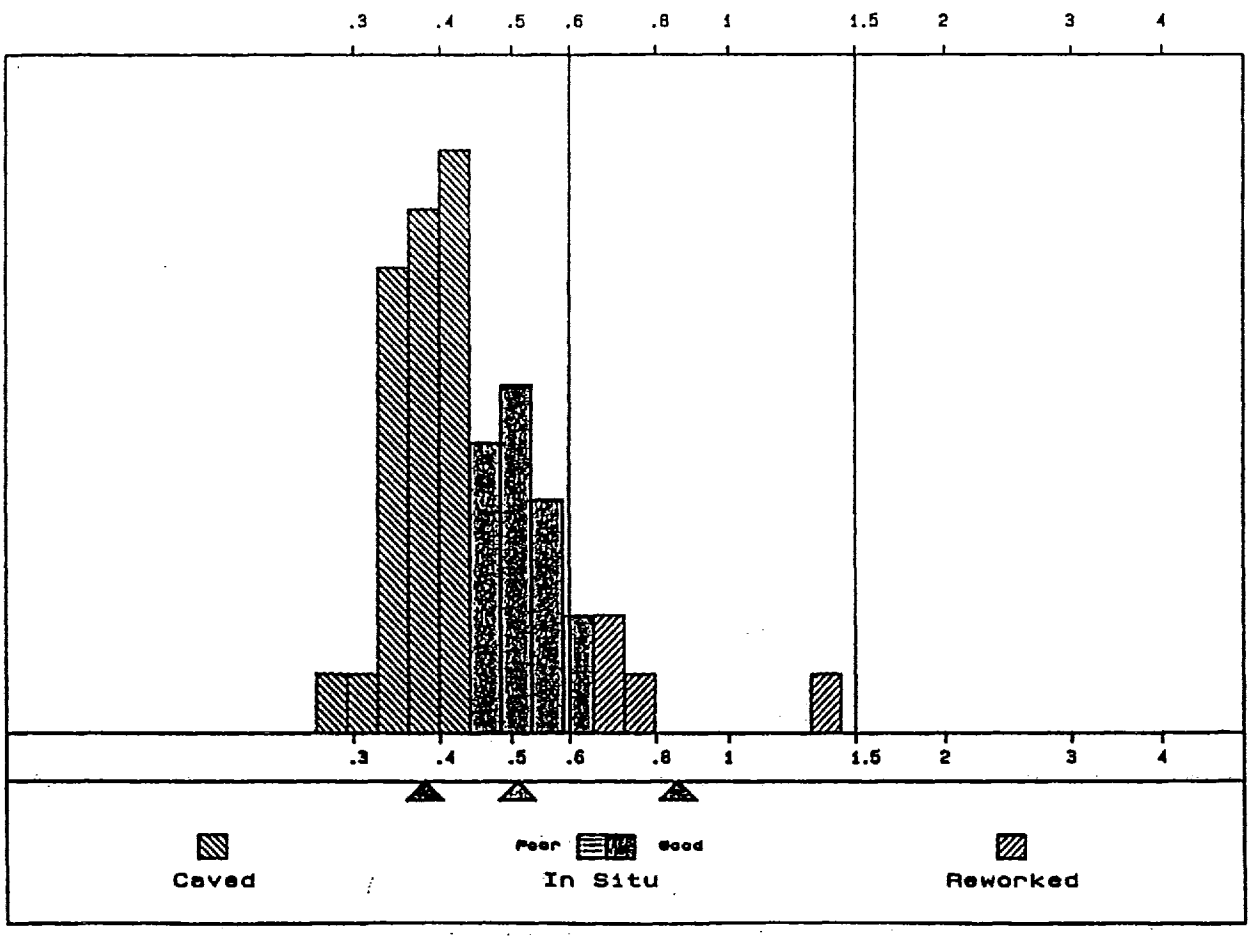


BUJAK DAVIES GROUP : VITRINITE MALASPINA#1A

SAMPLE : 9090f

Population	Mean	Standard Deviation
In Situ	0.51	0.05
Caved	0.38	0.04
Reworked	0.84	0.30
Total	0.46	0.15

Total measurements this sample : 50

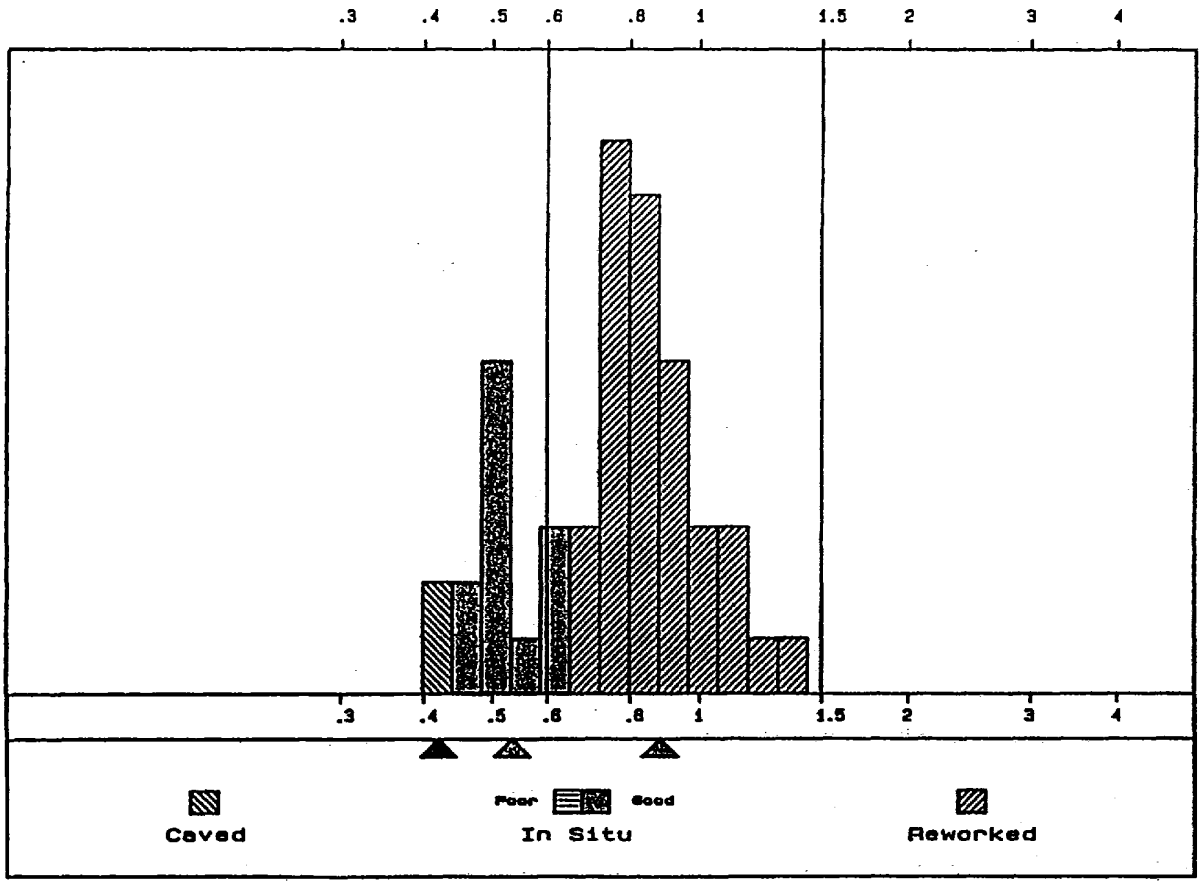


BUJAK DAVIES GROUP : VITRINITE MALASPINA#1A

SAMPLE : 9810f

Population	Mean	Standard Deviation
In Situ	0.53	0.06
Caved	0.42	0.02
Reworked	0.86	0.17
Total	0.77	0.21

Total measurements this sample : 50

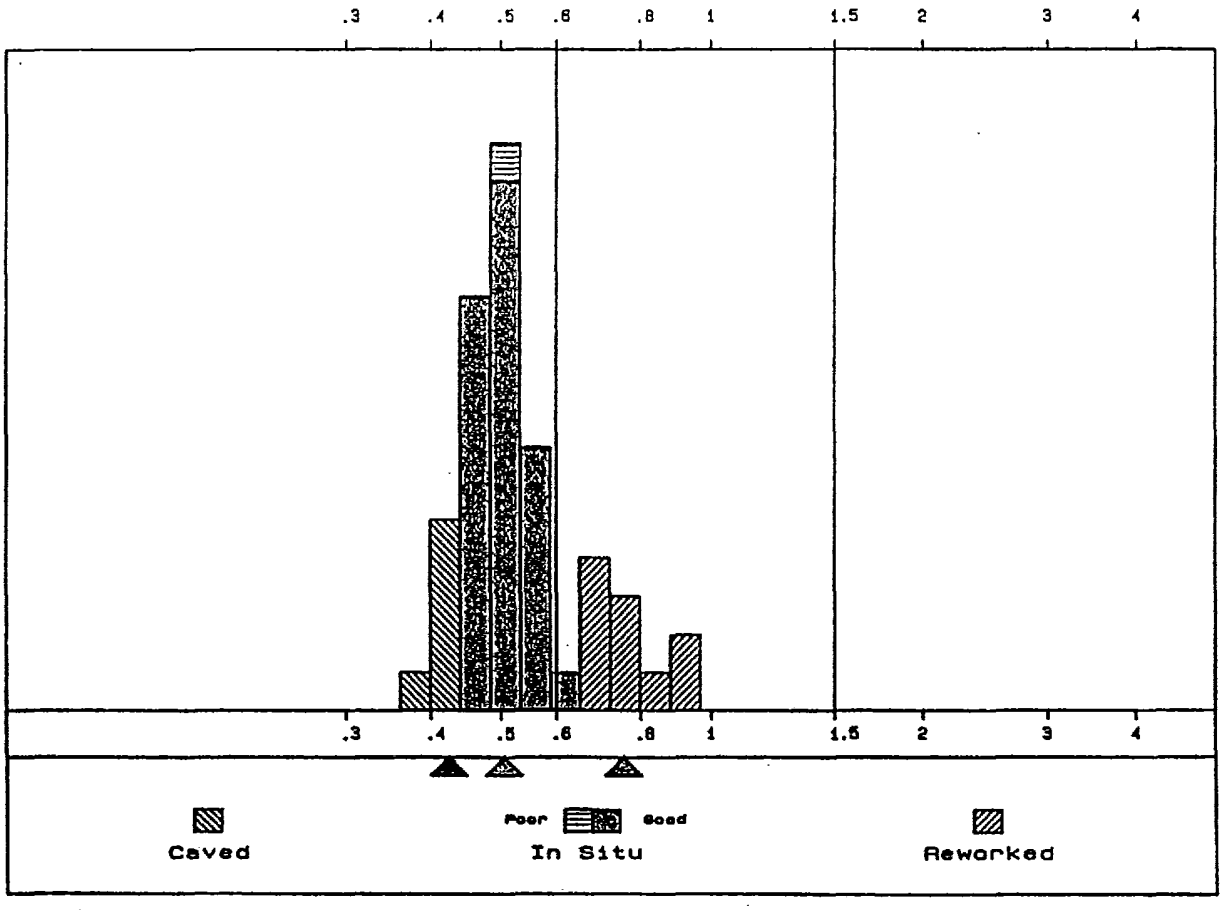


BUJAK DAVIES GROUP : VITRINITE MALASPINA#1A

SAMPLE : 10560f

Population	Mean	Standard Deviation
In Situ	0.50	0.04
Caved	0.42	0.02
Reworked	0.74	0.09
Total	0.54	0.12

Total measurements this sample : 50

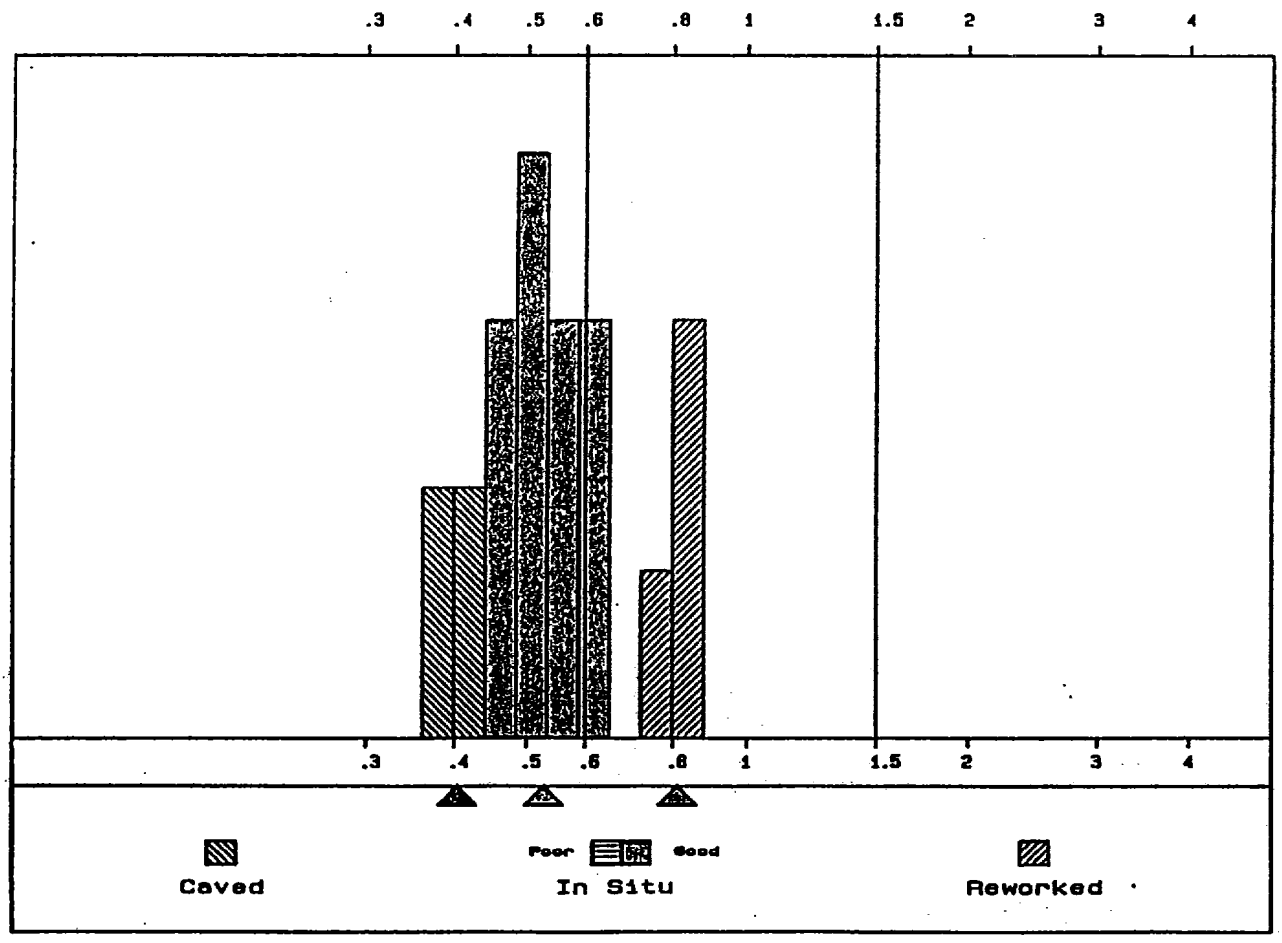


BUJAK DAVIES GROUP : VITRINITE MALASPINA#1A

SAMPLE : 11160f

Population	Mean	Standard Deviation
In Situ	0.52	0.06
Caved	0.40	0.02
Reworked	0.79	0.05
Total	0.56	0.14

Total measurements this sample : 35

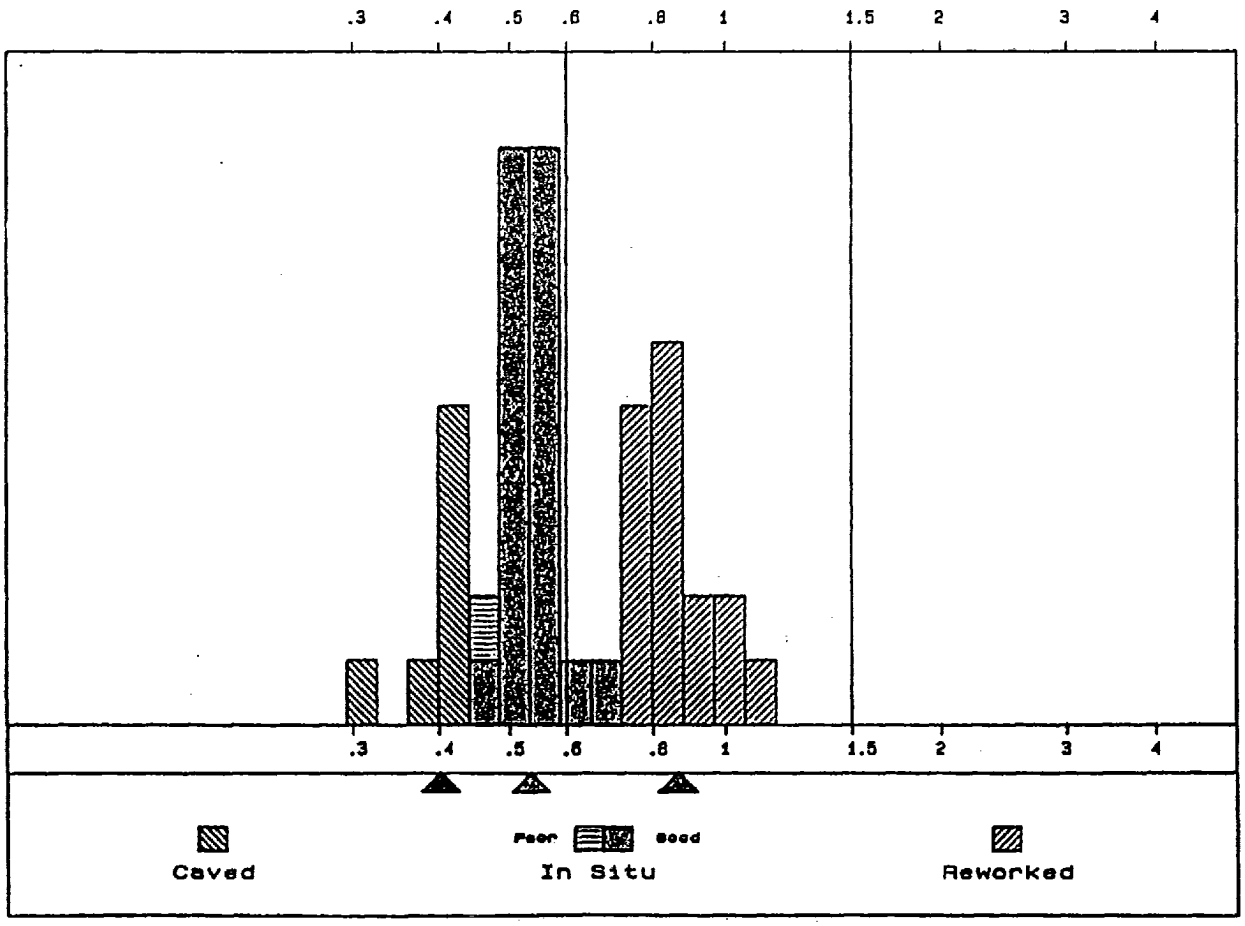


BUJAK DAVIES GROUP : VITRINITE MALASPINA#1A

SAMPLE : 11880f

Population	Mean	Standard Deviation
In Situ	0.53	0.05
Caved	0.40	0.04
Reworked	0.84	0.11
Total	0.62	0.19

Total measurements this sample : 45

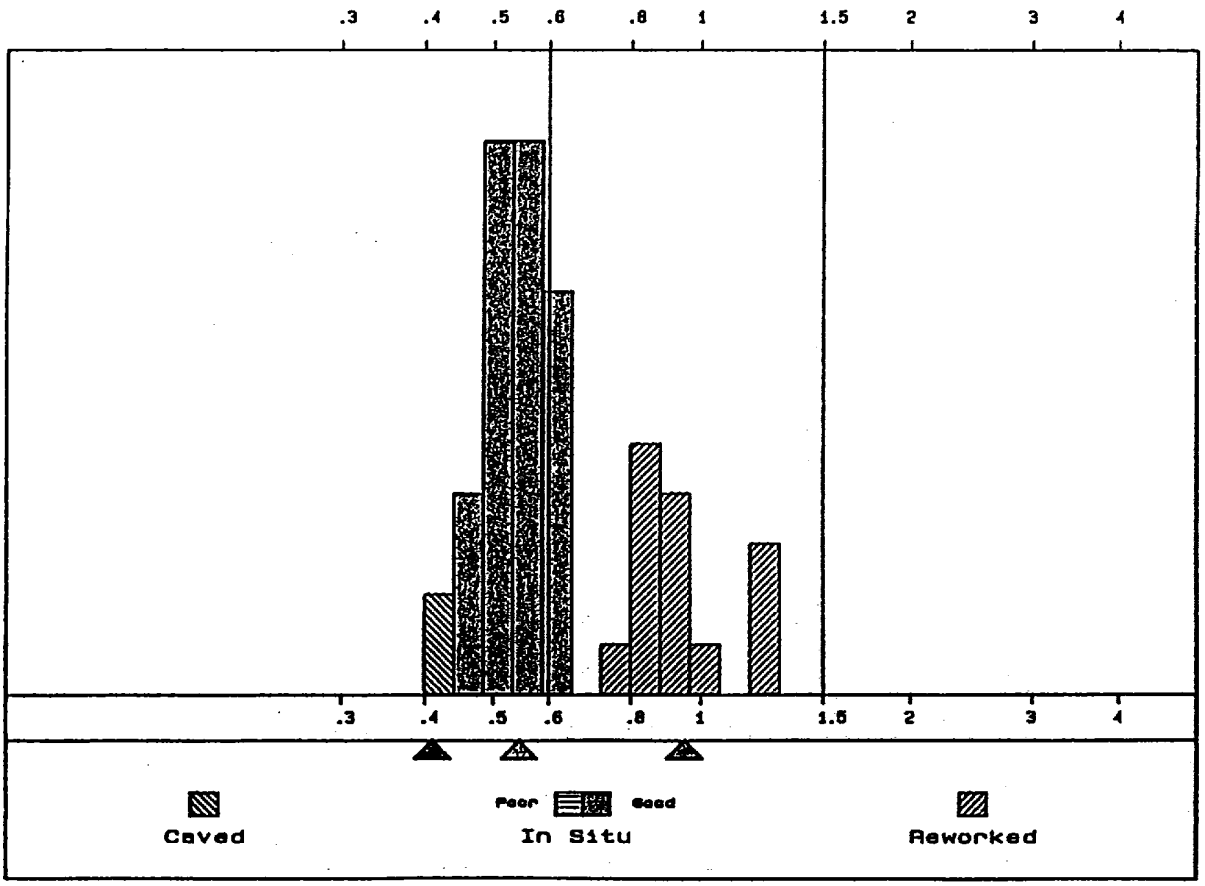


BUJAK DAVIES GROUP : VITRINITE MALASPINA#1A

SAMPLE : 12510f

Population	Mean	Standard Deviation
In Situ	0.54	0.06
Caved	0.40	0.00
Reworked	0.93	0.16
Total	0.64	0.21

Total measurements this sample : 60

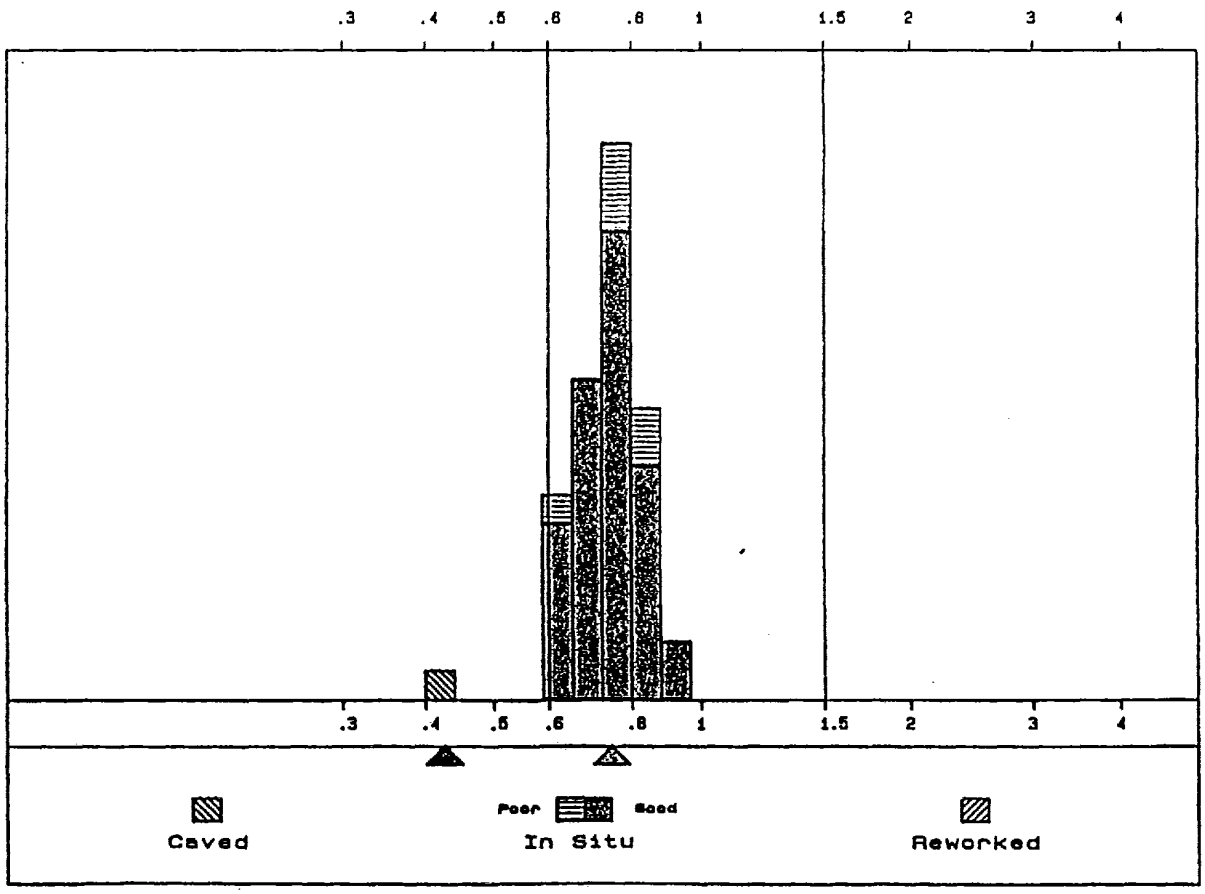


BUJAK DAVIES GROUP : VITRINITE MALASPINA#1A

SAMPLE : 13350f

Population	Mean	Standard Deviation
In Situ	0.73	0.07
Caved	0.42	-
Reworked	-	-
Total	0.72	0.08

Total measurements this sample : 50



BUJAK DAVIES GROUP : VITRINITE MALASPINA#1A

SAMPLE : 13816f

Population	Mean	Standard Deviation
In Situ	0.80	0.10
Caved	0.58	-
Reworked	1.17	0.06
Total	0.83	0.15

Total measurements this sample : 50