

PE900100

PETROLEUM DIVISION

SPECIAL CORE ANALYSIS REPORT
of
MINERVA 2A
for
BHP PETROLEUM PTY LTD
by
ACS LABORATORIES PTY LTD

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CHAPTER 1

Introduction

1. INTRODUCTION

This final report presents the results obtained, and details of the procedures employed, from a special core analysis study performed on a suite of plug samples from the Minerva-2A Well. The original instructions for analysis were received from BHP Petroleum Pty Limited with the Request for Quotation (Ref 99-84309, dated 10th May, 1994). This document also included brief methodology and sample selection. Following discussions between BHP and ACS technical personnel, some modifications were made to the test program. Confirmation to initiate testing was received (via a Work Order document) on 25th July, 1994.

The report contains results from the following analyses:

- Gas Permeability at Irreducible Brine Saturation
- Brine Permeability at Residual Gas Saturation
- Various Single Point and Full Curve Drainage and Imbibition Capillary Pressure Analyses
- Basic Waterflood Analyses
- Mercury Injection Capillary Pressure Analyses

Chapter 2 of this report presents a brief overview of the entire study in the form of summary tables, flowcharts and pictorials. The test procedures and result calculations are detailed in Chapter 3, with the full listing of results in Chapter 4. Finally a brief interpretation of the results is presented in Chapter 5. The appendices list any relevant ancillary information pertinent to the study.

CHAPTER 2

Summary of Test Programme

2.1a

**SAMPLE IDENTIFICATION
(Lithofacie Order)**

Sample Number	Depth	Hydraulic Unit	Lithofacie Unit
27	1841.70	1	1
61	1851.90	1	1
38	1845.00	1	1
50	1848.60	1	1
69	1854.30	1	1
49	1848.30	1	1
31	1842.90	2	2
153	1880.10	2	2
219	1932.10	2	2
80	1858.20	2	2
53	1849.50	2	3
341	1968.80	2	3
334	1966.70	3	4
43	1846.50	3	4
105	1865.70	3	5
122	1870.80	3	5
117	1869.30	3	5
118	1869.60	3	5
158	1881.60	4	6
312	1960.10	4	6
163	1915.30	4	6
283	1951.40	4	6
77	1857.30	4	6
225	1933.90	4	6
161	1882.50	5	7
266	1946.30	5	7
111	1867.53	5	8a
142	1876.80	5	8a
104	1865.40	5	8a
172	1918.00	5	8a
216	1931.20	6	8b
306	1958.30	6	8b
220	1932.40	6	9a
230	1935.40	6	9a
108	1866.60	6	9a
273	1948.40	6	9a

2.1b

**SAMPLE IDENTIFICATION
(Depth Order)**

Sample Number	Depth	Hydraulic Unit	Lithofacie Unit
27	1841.70	1	1
31	1842.90	2	2
38	1845.00	1	1
43	1846.50	3	4
49	1848.30	1	1
50	1848.60	1	1
53	1849.50	2	3
61	1851.90	1	1
69	1854.30	1	1
77	1857.30	4	6
80	1858.20	2	2
104	1865.40	5	8a
105	1865.70	3	5
108	1866.60	6	9a
111	1867.53	5	8a
117	1869.30	3	5
118	1869.60	3	5
122	1870.80	3	5
142	1876.80	5	8a
153	1880.10	2	2
158	1881.60	4	6
161	1882.50	5	7
163	1915.30	4	6
172	1918.00	5	8a
216	1931.20	6	8b
219	1932.10	2	2
220	1932.40	6	9a
225	1933.90	4	6
230	1935.40	6	9a
266	1946.30	5	7
273	1948.40	6	9a
283	1951.40	4	6
306	1958.30	6	8b
312	1960.10	4	6
334	1966.70	3	4
341	1968.80	2	3

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2.2 TEST ALLOCATION SEQUENCE

Sample Number	Sat	Full Curve Cent-D ABPc	SngPnt Cent-D ABPc	Kg @ Swir	SngPnt Cent-I ABPc	Kw @ Sgr	Re Sat 100% Sw	SngPnt Cent-D&I ABPc	SngPnt PP-D ABPc	Kg @ Swir	Basic Waterflood	Kw @ Sgr	SngPnt Cent I ABPc	Hg Inj Offcuts
27	27	27		27	27	27								
61	61		61	61	61	61	61	61						
38	38	38		38	38	38								
50	50		50	50	50	50	50		50	50	50	50	50	
69	69	69		69	69	69								69
49	49		49	49	49	49								
31	31	31		31	31	31								
153	153		153	153	153	153	153	153						
219	219	219		219	219	219								
80	80		80	80	80	80	80		80	80	80	80	80	
53	53	53		53	53	53								53
341	341		341	341	341	341								
334	334	334		334	334	334								
43	43		43	43	43	43	43	43						
105	105	105		105	105	105								
122	122		122	122	122	122	122		122	122	122	122	122	
117	117	117		117	117	117								117
118	118		118	118	118	118								

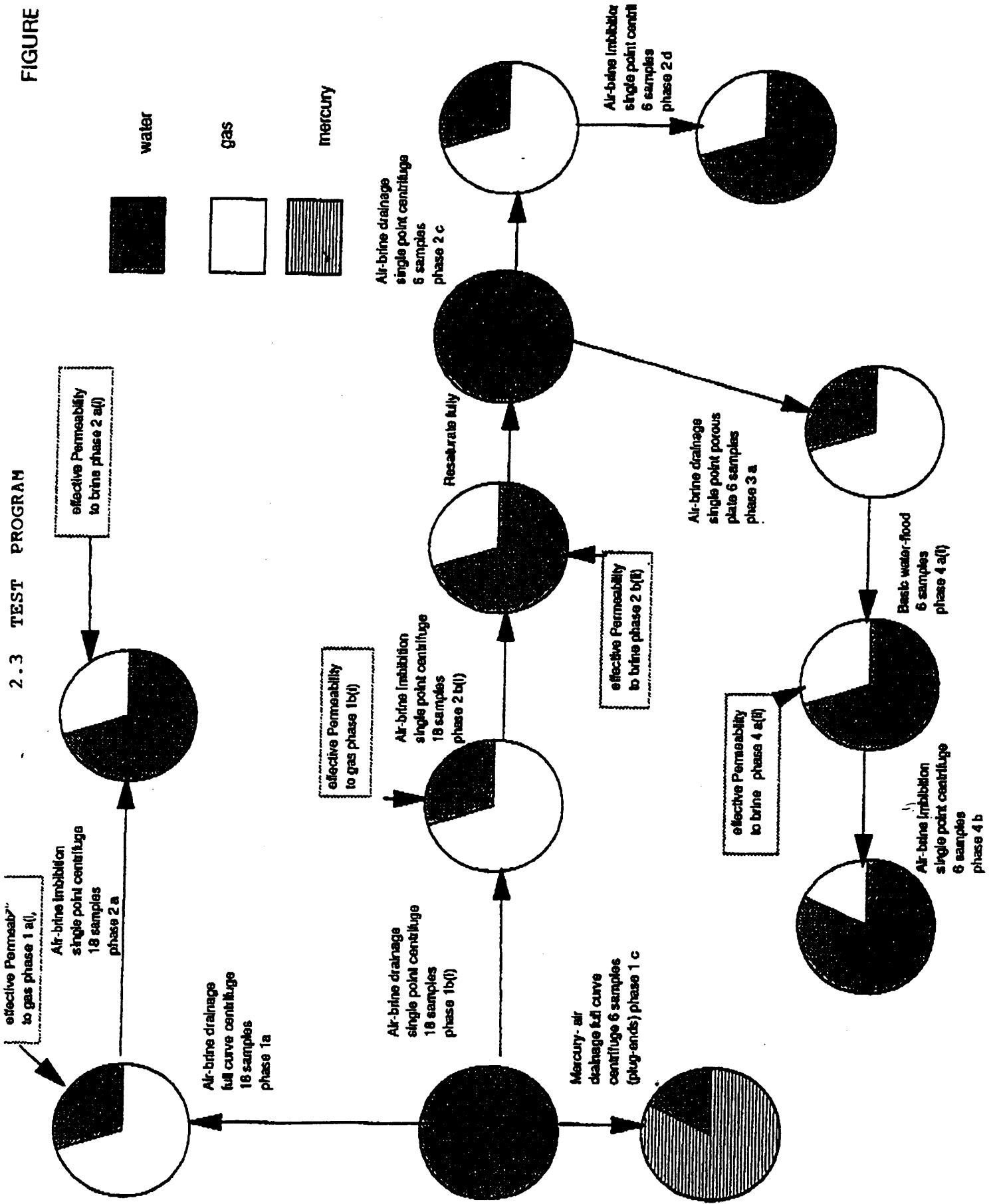
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2.2 TEST ALLOCATION SEQUENCE

Sample Number	Sat	Full Curve Cent-D ABPc	SngPnt Cent-D ABPc	Kg @ Swir	SngPnt Cent-I ABPc	Kw @ Sgr	Re Sat 100% Sw	SngPnt Cent-D&I ABPc	SngPnt PP-D ABPc	Kg @ Swir	Basic Waterflood	Kw @ Sgr	SngPnt Cent I ABPc	Hg Inj Offcuts
158	158	158	158	158	158	158								
+312	312		312	312	312	312	312	312						
163	163	163	163	163	163	163								
283	283		283	283	283	283	283	283	283	283	283	283	283	
77	77	77	77	77	77	77								77
225	225		225	225	225	225	225							
161	161	161	161	161	161	161								
266	266		266	266	266	266	266	266	266	266				
111	111	111	111	111	111	111								
142	142		142	142	142	142	142	142	142	142	142	142	142	
104	104	104	104	104	104	104								104
172	172		172	172	172	172	172							
216	216	216	216	216	216	216								
306	306		306	306	306	306	306	306	306	306				
220	220	220	220	220	220	220								
230	230		230	230	230	230	230	230	230	230	230	230	230	
108	108	108	108	108	108	108								108
273	273		273	273	273	273	273	273	273	273	273	273	273	

2.3 TEST PROGRAM

FIGURE



CHAPTER 3

Test and Calculation Procedures

3. TEST AND CALCULATION PROCEDURES

3.1 Sample Preparation

The suite of 36 samples selected (by BHP) for analysis had been drilled and utilised for the routine core analysis of this well. Each of these samples was one-and-a-half inches in diameter and circa three inches in length. Upon receipt of the instructions, the samples were inspected by a geologist and a SCA engineer. Due to insufficient sample length and/or fractures sample 265 was deemed unsuitable for analysis. Replacement sample number 312 was selected by BHP.

3.2 Sample Cleaning

As a pre-cautionary measure the samples were then cleaned by cool solvent extraction using a modified soxhlet system, to ensure the refluxing solvent in the samples was at ambient temperature. Refluxing (using a 3:1 chloroform:methanol azeotrope) was continued until tests for oil (fluorescence under ultra violet light) and salt (silver nitrate precipitation) showed negative. The clean samples were dried to constant weights in an oven at 50°C and 50% relative humidity.

3.3 Base Parameter Determinations

Gas (nitrogen) permeability measurements were made on the clean and dry plug samples, individually loaded in a Hassler core holder, with an applied overburden stress of 250 psi. Nitrogen gas was flowed through the sample and the differential pressure (across the sample) was measured. The permeability value was calculated by application of Darcy's Law.

Porosity values were determined indirectly by the following stages:

1. The grain volume of each sample was measured by expansion of helium gas from standard volumes into the sample loaded in a matrix cup. Pressure values were monitored by an electronic transducer. The grain volume was derived by applying Boyle's law to the data.
2. The complete saturation of the twelve samples was achieved in two stages. Firstly the samples were loaded into an airtight container and the system evacuated. Brine was then introduced and the system pressured up to 1600 psi for approximately 24 hours.
3. Upon releasing the pressure the samples were weighed and from this the percentage pore space occupied by brine was calculated. The samples then proceeded to the test programme after the saturation was checked to be within specified limits.
4. Bulk volumes were determined by immersion in brine and applying Archimedes principle to the data.

$$\text{Bulk Volume} = \frac{\text{Weight of Fluid Displaced}}{\text{Fluid Density}}$$

$$\text{Pore Volume} = \text{Bulk Volume} - \text{Grain Volume}$$

$$\text{Porosity} = \frac{\text{Pore Volume}}{\text{Bulk Volume}} \times 100$$

The samples were then separated into two groups of 18, according to the BHP test allocation.

3.4 Group A

3.4.1 Centrifugation to Irreducible Brine Saturation (Swir)

A suite of 18 fully brine saturated samples were placed in individual centrifuge cups. The cups were then loaded into the centrifuge for single point air/brine capillary pressure displacement to irreducible brine saturation (Swir). A maximum rotor speed was used that is equivalent to an approximate capillary pressure of 30 psi. The brine volumes displaced by centrifugal forces were monitored as a function of elapsed time. As standard practises require, the samples were left at each rotational speed for a minimum of 24 hours, or until there was no change in consecutive readings of produced water. As a quality control check, the produced volumes were verified by mass balance (using the sample weights) before and after centrifuging, and the density of the two fluids.

3.4.2 Gas Permeability Determinations @ Swir

Upon completion of the above, each sample was loaded into individual core holders and a net overburden of 250 psi was applied. Gas permeability (@ Swir) was then determined for each sample (using procedures as described in Section 3.3). During the course of analysis, the overburden pressure was amended by BHP to 2100 psi.

3.4.3 Centrifugation to Residual Gas Saturation (Sgr)

The 18 samples were then re-loaded into the centrifuge immersed in brine. Residual gas saturations were derived by single point centrifugation at an equivalent capillary pressure of approximately 30 psi. Saturation data were determined volumetrically and verified by mass balance.

3.4.4 Brine Permeability Determinations (@ Sgr)

Upon completion of the centrifugation the samples were loaded into hydrostatic core holders and a net overburden pressure of 2100 psi applied. Brine was flowed through each sample and the permeability to brine (K_w @ Sgr) was determined as follows:

$$K_w = 14696 \times \frac{Q}{\Delta_p} \times \frac{L}{A} \times \mu T$$

where 14696	=	units conversion
Q	=	brine flow rate (cc/sec)
Δ_p	=	differential flooding pressure across the sample (psi)
L	=	sample length (cms)
A	=	sample cross-sectional area (cms ²)
μ	=	brine viscosity (cP) @ temperature T°C

3.4.5 Basic Low Rate Waterflood

A sub-suite of 6 Group A samples (selected by BHP) were then re-cleaned, dried and fully brine saturated using the procedures as described previously. The samples were then de-saturated to irreducible brine saturation (S_{wir}). This was achieved, in accordance with BHP instructions, by porous plate. The six samples were loaded onto a 5 bar rated porous plate in a capillary pressure cell. A diatomaceous earth (Kiesulguhr) was used to enhance the capillary contact of the samples with the plate. Sample de-saturation was achieved using humidified gas at 70 psi. The samples were allowed to reach equilibrium saturation over a period of 14 days. Daily readings of produced volume were recorded as a function of elapsed time and a graph plotted. Sample saturation (S_w) was determined by mass balance.

Each sample was then loaded into individual core holders and an overburden pressure of 2100 psi applied. Gas permeability as a function of S_{wir} was then determined. The waterflood to residual gas saturation (S_{gr}) was performed with degassed simulated formation brine at a constant flooding rate of 4cc per hour. During the flood, incremental volumes of gas and brine were recorded. Flooding was continued until a brine:gas production ratio in excess of 3000:1 and less than 0.5% oil production in three consecutive readings was achieved. At flood-out the brine permeability at residual gas saturation ($K_w @ S_{gr}$) was determined for each sample.

In an attempt to compare S_{gr} values, the samples were removed from the core holders and placed into the centrifuge for an additional single point S_{gr} .

3.4.6 Capillary Pressure - Mercury Injection (Air-Mercury)

Offcuts from the samples were utilised for capillary pressure determinations by the mercury injection technique. The mercury injection apparatus used is a semi-automatic Micromeritics Autopore 9200 which operates up to a pressure of 60,000 psia, and can measure intrusions as small as 0.0001 cm³ per gram of sample. This instrument was chosen for these analyses as opposed to the standard mercury pump because of its greater accuracy and ability to reach very high pressures. This was thought to be important as mineralogical studies had indicated that microporosity could be present in these samples in association with clay platelets.

The Micromeritics Autopore records mercury intrusion by measuring the capacitance change between the capillary of mercury contained in the penetrometer and an outer metal sheath as mercury invades the samples. For pressures up to 24 psia, air pressure is used. Hydraulic oil is used to achieve the higher pressures. No volume corrections for pressure effects were made, since below 24 psia they are negligible, whilst for higher pressures, the penetrometer experiences equal external and internal pressures and mercury compression is offset by penetrometer compression.

All samples were dried in a vacuum oven at temperatures not exceeding 90°C and placed into calibrated glass penetrometers. These consist of a sample chamber and attached precision bore capillary. The sample sizes were selected so that the estimated pore volume was less than the capillary volume. Once the samples were placed into the penetrometer a vacuum was applied until less than 50 micro-metres of mercury had been achieved. Mercury was then introduced into the penetrometer and the run commenced along pre-defined pressure points on a logarithmic scale. After equilibration at each pressure point a capacitance reading was taken which was then converted into an equivalent intrusion volume.

3.5 Group B

3.5.1 Capillary Pressure - Centrifuge (Air-Water Drainage)

The 18 samples selected (by BHP) for these analyses (after saturation with the brine using the procedures described in Section 3.3) were placed into individual drainage cups and loaded into the centrifuge. At each rotor speed, the water displaced by centrifugal forces was monitored as a function of time. As standard practices require¹, samples were left at each rotational speed for a minimum of 24 hours, or until there was no change in consecutive readings of produced water. The induced capillary pressures were then calculated from the following equation²:-

$$P_c = \frac{1}{2} \Delta \rho \omega^2 (r_2^2 - r_1^2) \times (1.013 \times 14.696 \times 10^{-6})$$

where: P_c = capillary pressure at the inlet face of the core (psi).

$\Delta \rho$ = density difference of the two fluids, ie. air and water (gms/cm³).

ω = angular velocity (rad/sec)
= $2\pi(\text{RPM})/60$

r_2 = radius from the centre of the centrifuge to the bottom of the core plug (cm).

r_1 = radius from the centre of the centrifuge to the top of the core plug (cm).

As a quality control check, to ensure samples had attained equilibrium at each rotational speed, plots of effluent displaced as a function of time were produced.

1

Omorieg, Zuwa, Factors Affecting the Equivalency of Different Capillary Pressure Measurement Techniques, S. Chevron Oilfield Research Co., SPE Formation Evaluation, March 1988, pp. 157-155.

2

Hassler, Brunner, Measurement of Capillary Pressures in Small Core Samples, AIME, Vol. 160, 1945, pp. 114-123.

The centrifuge method of determining the relation between saturation and capillary pressure provides values of average saturation. These average saturation values must then be converted to obtain the endface saturation which is equivalent to the induced capillary pressure, thereby obtaining the true profile of capillary pressure versus saturation. The true endface saturation has been calculated by applying a series of data regressions to the average saturation values and is the value to be used in reservoir modelling.

3.5.2 Gas Permeability Determinations @ Swir

Upon completion of the above, each sample was loaded into individual core holders and a net overburden of 2100 psi. Gas permeability (@ Swir) was then determined for each sample (as described in Section 3.3).

3.5.3 Centrifugation to Residual Gas Saturation (Sgr)

The 18 samples were then re-loaded into the centrifuge immersed in brine. Residual gas saturations were derived by single point centrifugation at an equivalent capillary pressure of approximately 30 psi. Saturation data were determined volumetrically and verified by mass balance.

3.5.4 Brine Permeability Determinations (@ Sgr)

Upon completion of the centrifugation the samples were loaded into hydrostatic core holders and a net overburden pressure of 2100 psi applied. Brine was flowed through each sample and the permeability to brine (Kw @ Sgr) was determined as follows:

$$K_w = 14696 \times \frac{Q}{\Delta_p} \times \frac{L}{A} \times \mu T$$

where 14696 = units conversion
 Q = brine flow rate (cc/sec)
 Δ_p = differential flooding pressure across the sample (psi)
 L = sample length (cms)
 A = sample cross-sectional area (cms²)
 μ = brine viscosity (cP) @ temperature T°C

CHAPTER 4

Test Results

POROSITY AND AIR PERMEABILITY

**Company
Well**

**BHP Petroleum Pty Ltd
Minerva 2A**

Phase: 0

Ambient

Sample Number	Depth, metres	Ambient Permeability to Air, milliDarcy's	Ambient Porosity, percent
27	1841.7	15007	16.6
31	1842.9	5981	21.2
38	1845	13913	20.5
43	1846.5	513	17.3
49	1848.3	7586	17.3
50	1848.6	13515	19.8
53	1849.5	1891	15.9
61	1851.9	14241	16.8
69	1854.3	7573	17.1
77	1857.3	348	13.9
80	1858.2	2415	16.1
104	1865.4	63	19.5
105	1865.7	3058	24.7
108	1866.6	1.95	9.4
111	1867.53	136	19.9
117	1869.3	2028	25.8
118	1869.6	1878	25.4
122	1870.8	2887	25.8
142	1876.8	129	18.4
153	1880.1	6441	21.9
158	1881.6	2230	21.5
161	1882.5	376	17.2
163	1915.3	968	19.8

POROSITY AND AIR PERMEABILITY

**Company
Well**

BHP Petroleum Pty Ltd
Minerva 2A

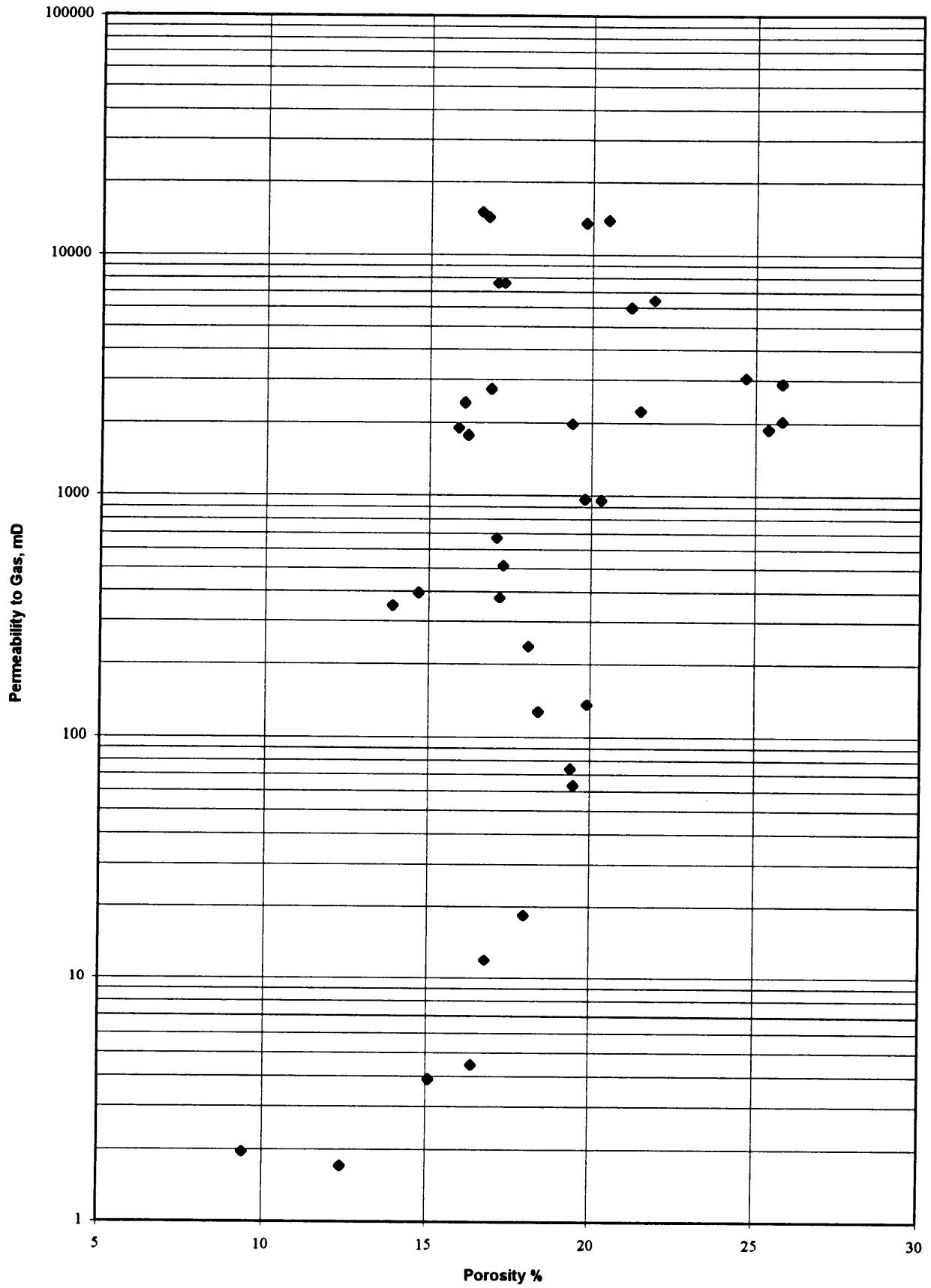
Phase: 0

Ambient

Sample Number	Depth, metres	Ambient Permeability to Air, milliDarcy's	Ambient Porosity, percent
172	1918.0	74	19.4
216	1931.2	18.5	18.0
219	1932.1	2736	16.9
220	1932.4	4.46	16.4
225	1933.9	394	14.7
230	1935.4	3.9	15.1
266	1946.3	237	18.1
273	1948.4	1.7	12.4
283	1851.4	958	20.3
306	1958.3	12	16.8
312	1960.1	1975	19.4
334	1966.7	668	17.1

Porosity vs Permeability to Air

Ambient



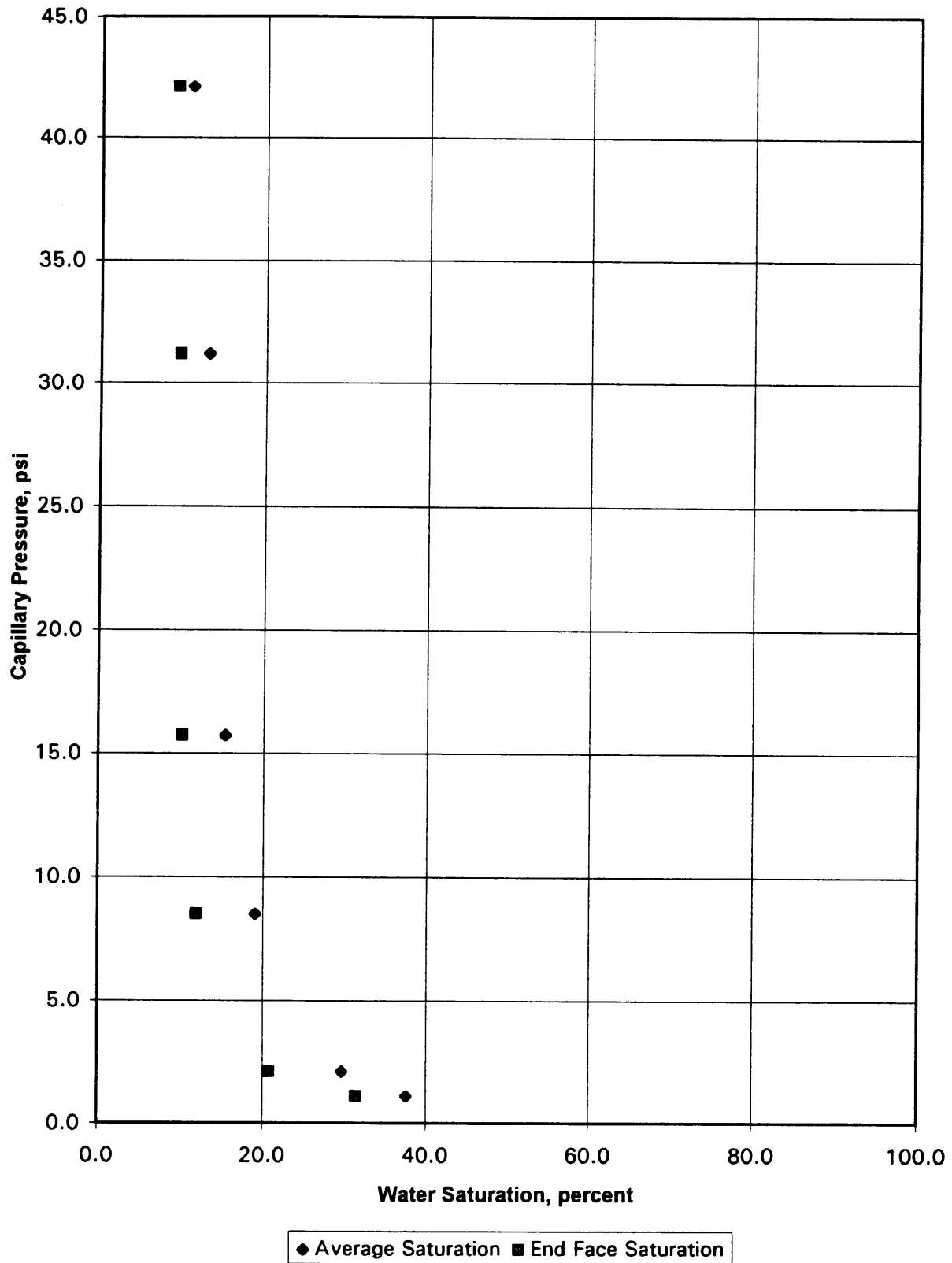
CAPILLARY PRESSURE

Company	BHP Petroleum Pty Ltd	Phase: 1a
Well	Minerva 2A	
Test Method	Centrifuge: Air/Brine Drainage	
Sample Number	27	
Depth	1841.70	metres
Permeability to Air	15007	millidarcys
Porosity	16.6	percent
Ambient		

Capillary Pressure (psi)	Average Saturation, percent	End-Face Saturation, percent
1.1	37.6	31.4
2.1	29.7	20.8
8.5	19.1	11.9
15.7	15.4	10.2
31.2	13.1	9.6
42.1	11.0	9.2

Capillary Pressure vs Water Saturation

Company: BHPP
Well: Minerva 2A
Sample: 27



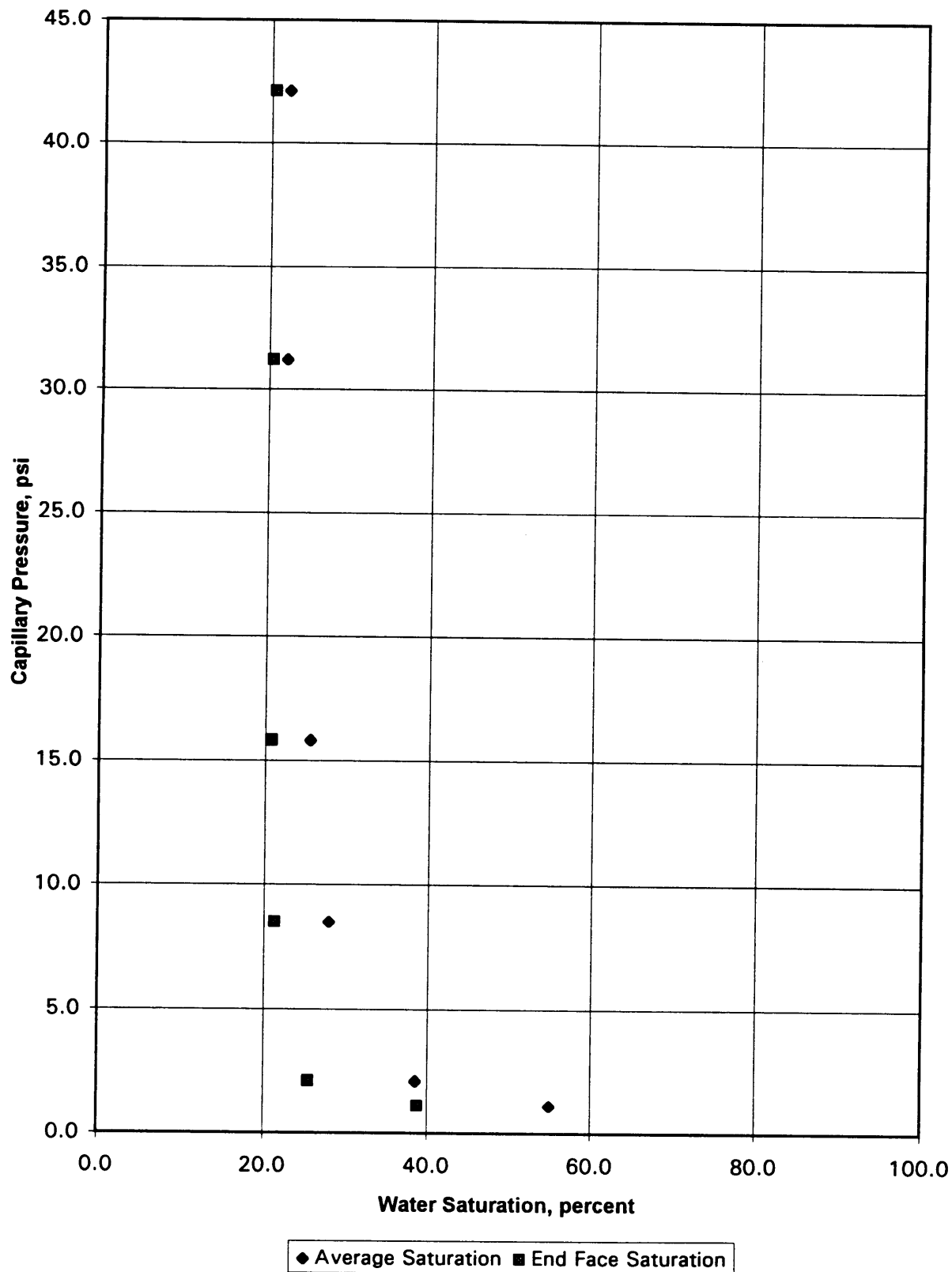
CAPILLARY PRESSURE

Company	BHP Petroleum Pty Ltd	Phase: 1a
Well	Minerva 2A	
Test Method	Centrifuge: Air/Brine Drainage	
Sample Number	31	
Depth	1842.90	metres
Permeability to Air	5981	millidarcys
Porosity	21.2	percent
Ambient		

Capillary Pressure (psi)	Average Saturation, percent	End-Face Saturation, percent
1.1	55.0	38.8
2.1	38.6	25.5
8.5	27.9	21.3
15.8	25.5	20.8
31.2	22.2	20.5
42.1	22.2	20.5

Capillary Pressure vs Water Saturation

Company: BHPP
Well: Minerva 2A
Sample: 31



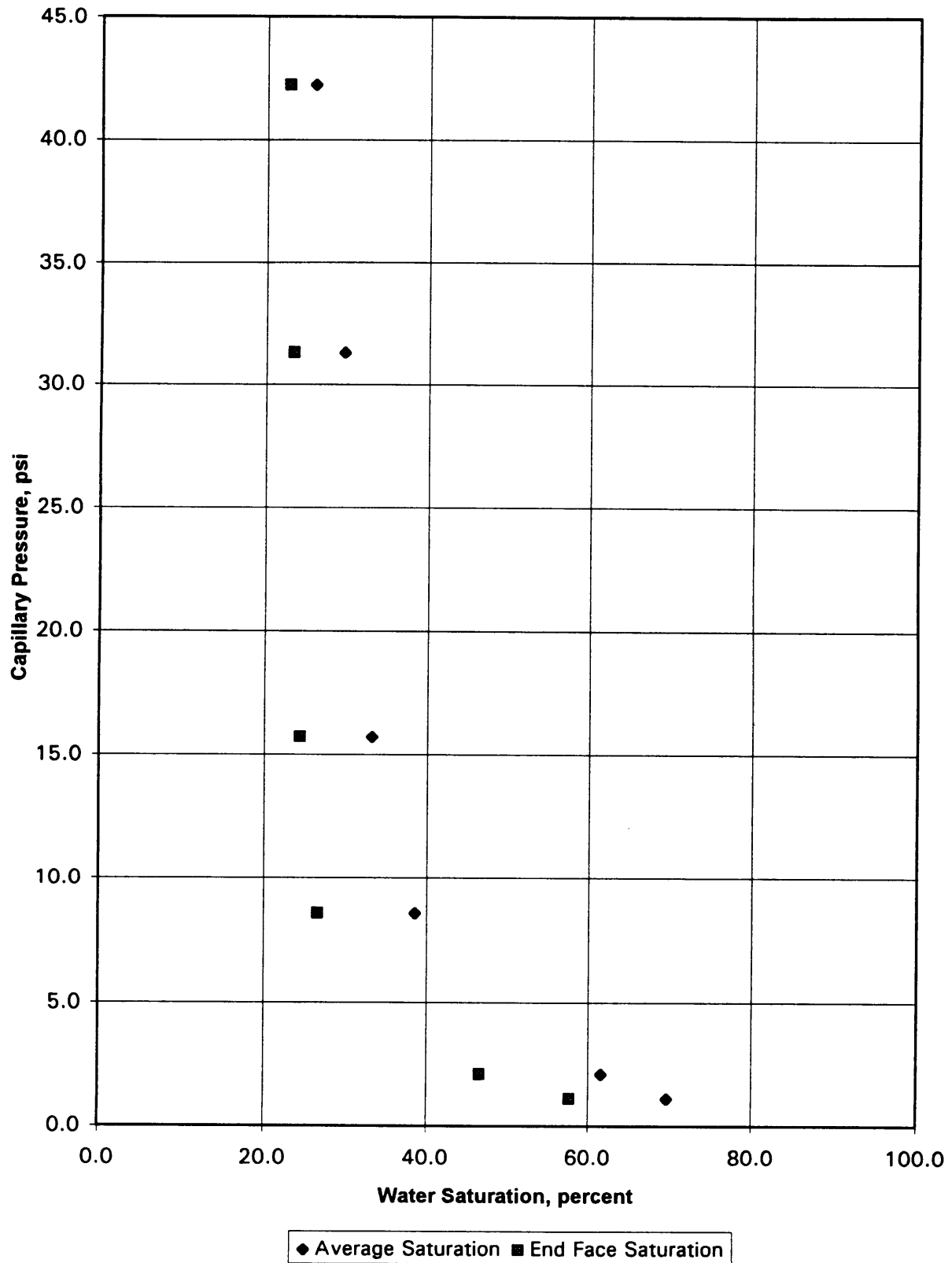
CAPILLARY PRESSURE

Company	BHP Petroleum Pty Ltd	Phase: 1a
Well	Minerva 2A	
Test Method	Centrifuge: Air/Brine Drainage	
Sample Number	38	
Depth	1845.00	metres
Permeability to Air	13913	millidarcys
Porosity	20.5	percent
Ambient		

Capillary Pressure (psi)	Average Saturation, percent	End-Face Saturation, percent
1.1	69.7	57.7
2.1	61.6	46.6
8.5	38.6	26.6
15.7	33.2	24.4
31.3	29.6	23.4
42.2	25.9	22.8

Capillary Pressure vs Water Saturation

Company: BHPP
Well: Minerva 2A
Sample: 38



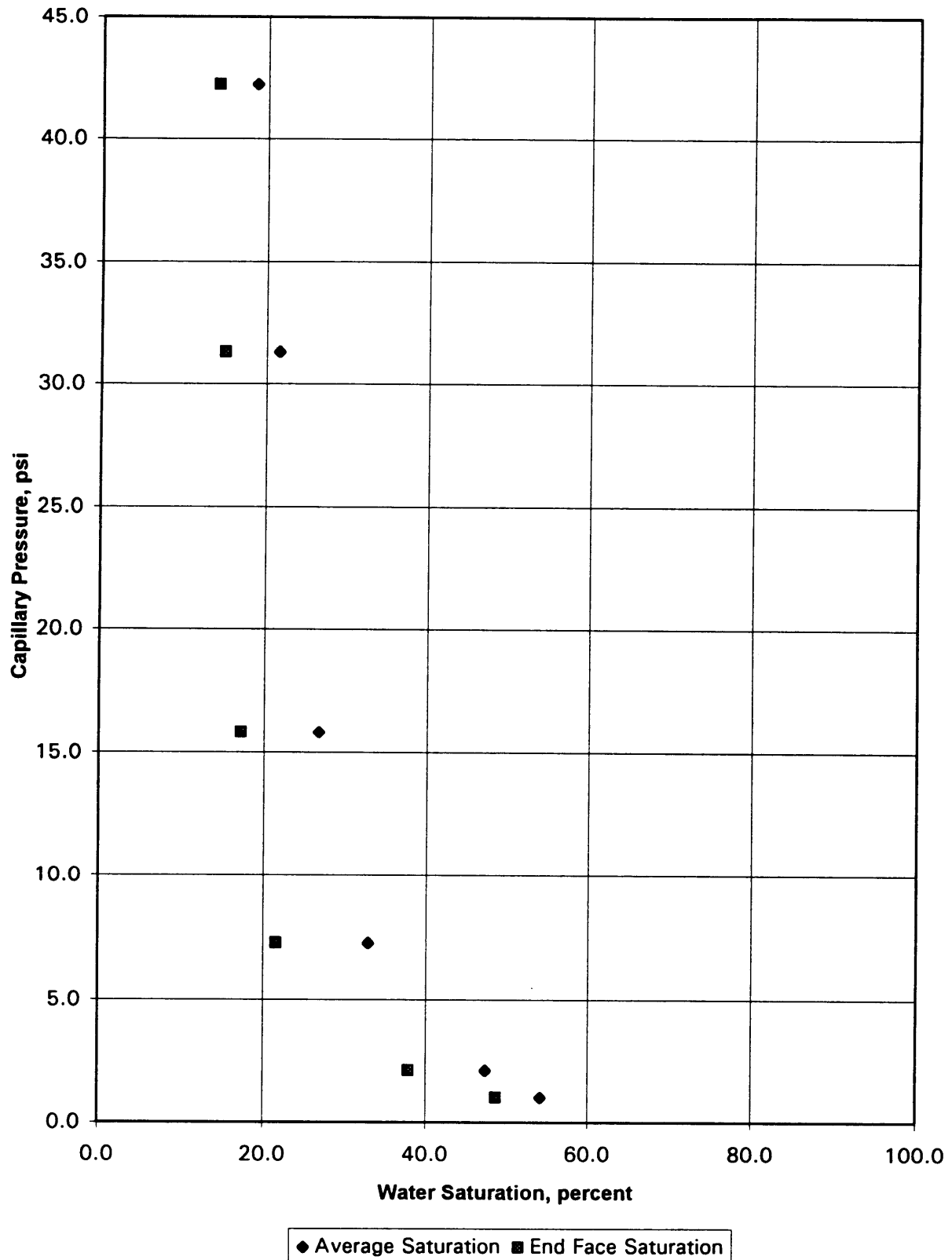
CAPILLARY PRESSURE

Company	BHP Petroleum Pty Ltd	Phase: 1a
Well	Minerva 2A	
Test Method	Centrifuge: Air/Brine Drainage	
Sample Number	53	
Depth	1849.50 metres	
Permeability to Air	1891 millidarcys	
Porosity	15.9 percent	
Ambient		

Capillary Pressure (psi)	Average Saturation, percent	End-Face Saturation, percent
1.0	54.2	48.7
2.1	47.4	37.9
7.3	32.9	21.6
15.8	26.7	17.2
31.3	21.6	15.0
42.2	18.7	14.1

Capillary Pressure vs Water Saturation

Company: BHPP
Well: Minerva 2A
Sample: 53



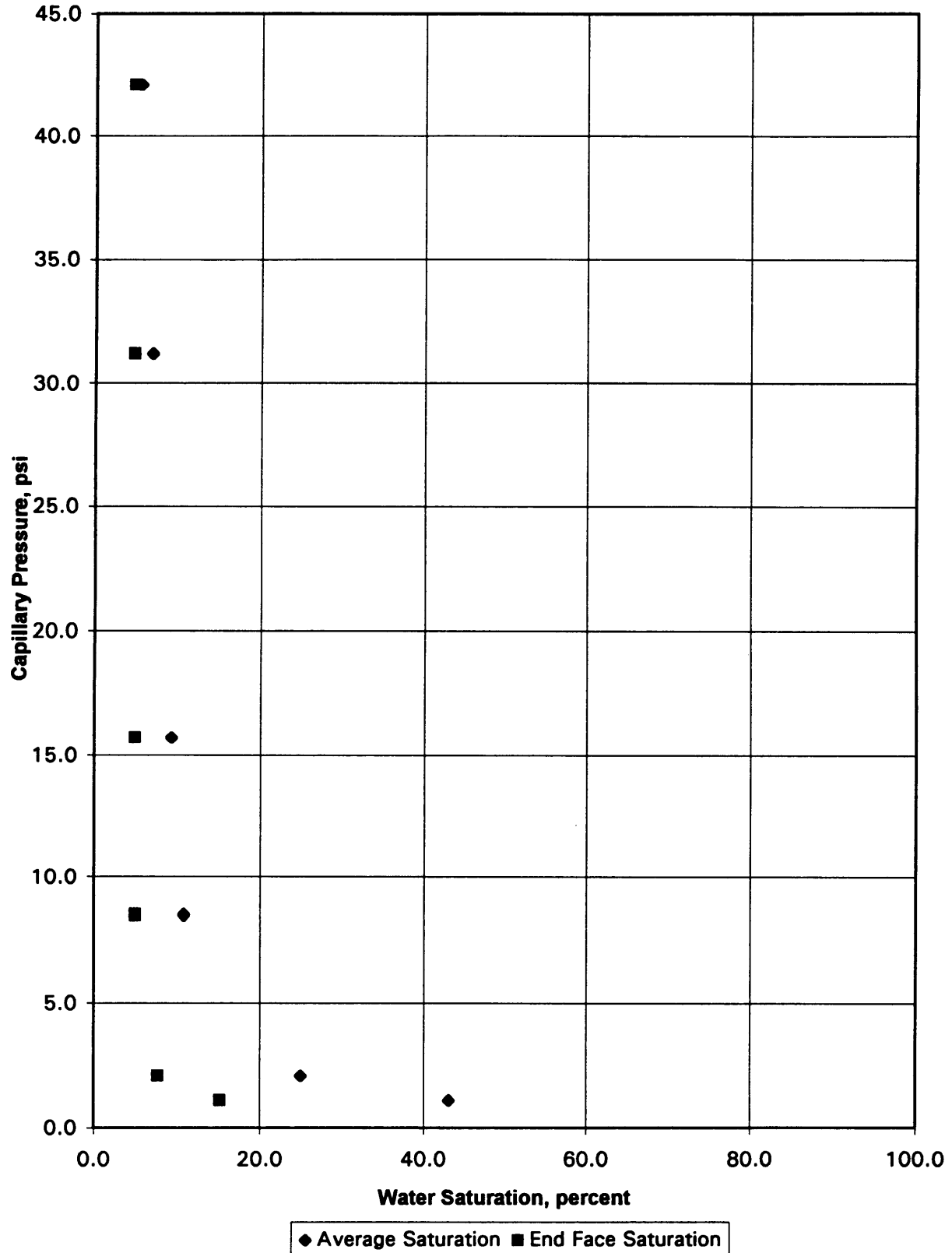
CAPILLARY PRESSURE

Company Well	BHP Petroleum Pty Ltd Minerva 2A	Phase: 1a
Test Method	Centrifuge: Air/Brine Drainage	
Sample Number	69	
Depth	1854.30 metres	
Permeability to Air	7573 millidarcys	
Porosity Ambient	17.1 percent	

Capillary Pressure (psi)	Average Saturation, percent	End-Face Saturation, percent
1.1	43.1	15.2
2.1	25.0	7.7
8.5	10.8	5.0
15.7	9.3	4.9
31.2	6.9	4.7
42.1	5.5	4.7

Capillary Pressure vs Water Saturation

Company: BHPP
Well: Minerva 2A
Sample: 69



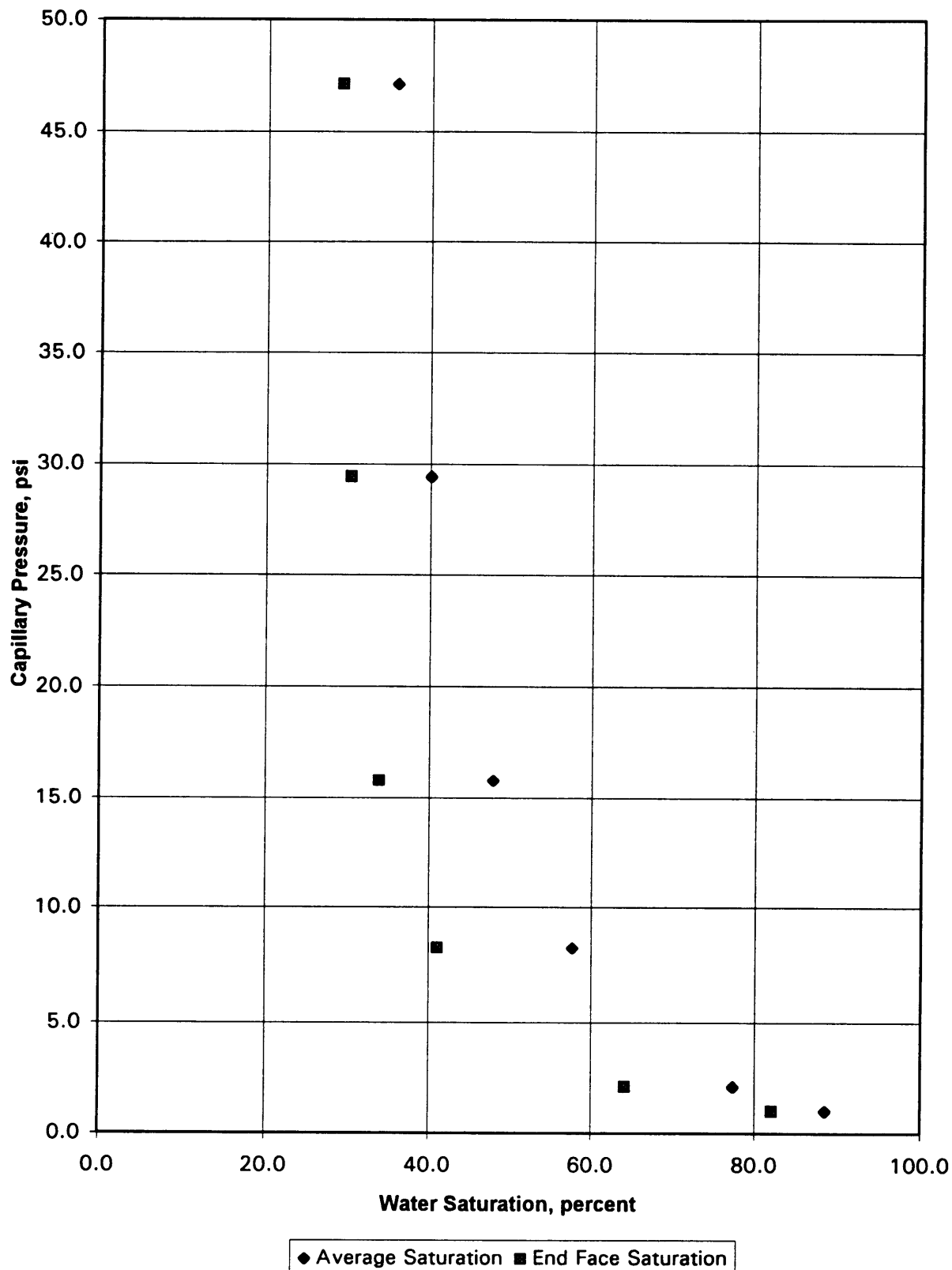
CAPILLARY PRESSURE

Company	BHP Petroleum Pty Ltd	Phase: 1a
Well	Minerva 2A	
Test Method	Centrifuge: Air/Brine Drainage	
Sample Number	77	
Depth	1857.30	metres
Permeability to Air	348	millidarcys
Porosity	13.9	percent
Ambient		

Capillary Pressure (psi)	Average Saturation, percent	End-Face Saturation, percent
1.0	88.5	82.1
2.1	77.4	64.2
8.3	57.7	41.1
15.8	47.9	33.9
29.4	40.1	30.3
47.1	35.8	29.1

Capillary Pressure vs Water Saturation

Company: BHPP
Well: Minerva 2A
Sample: 77



CAPILLARY PRESSURE

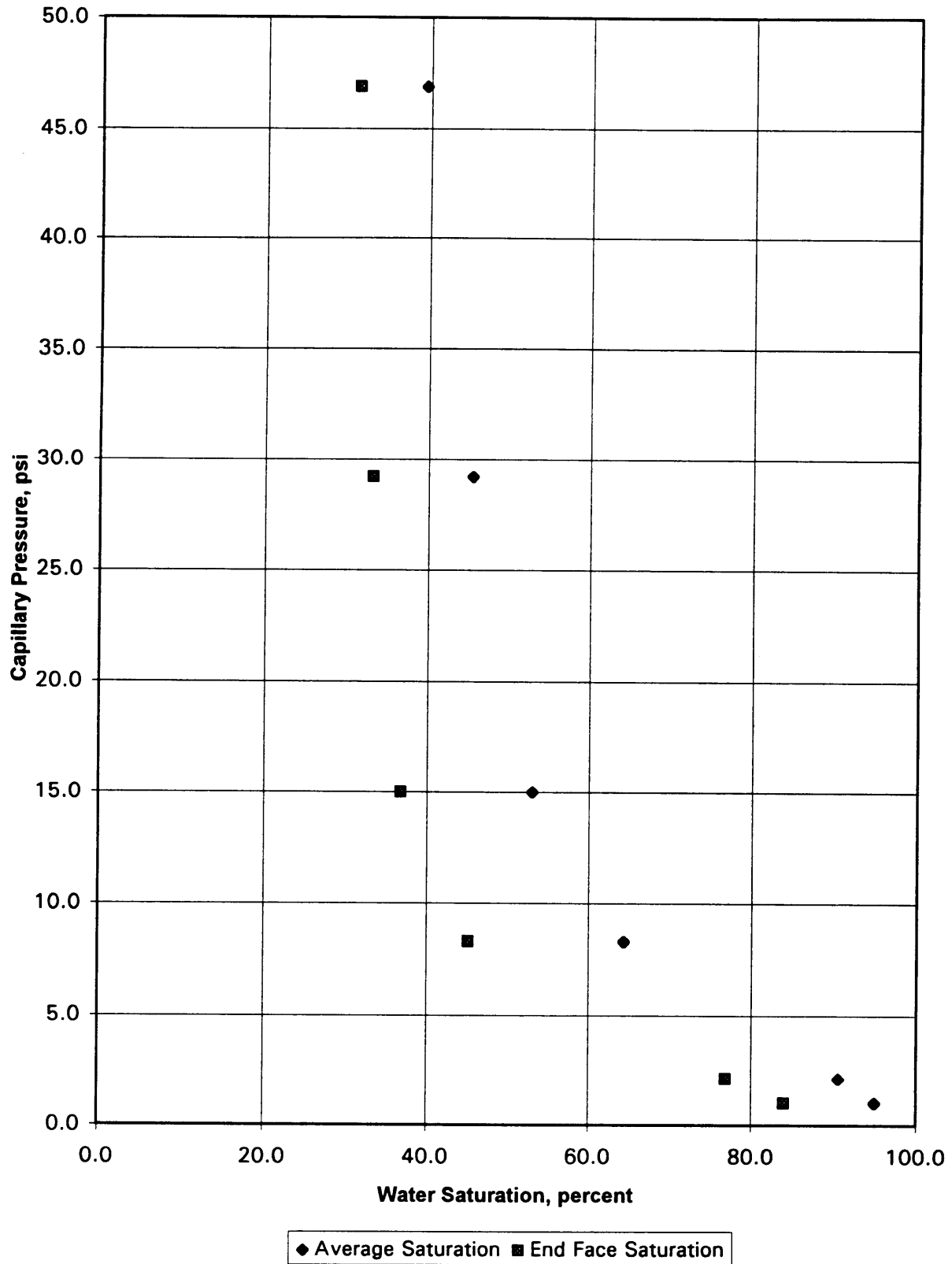
Company BHP Petroleum Pty Ltd **Phase: 1a**
Well Minerva 2A

Test Method Centrifuge: Air/Brine Drainage
Sample Number 104
Depth 1865.40 metres
Permeability to Air 63.3 millidarcys
Porosity 19.5 percent
Ambient

Capillary Pressure (psi)	Average Saturation, percent	End-Face Saturation, percent
1.0	95.0	84.0
2.1	90.6	76.9
8.3	64.4	45.2
15.7	53.0	36.8
29.2	45.5	33.2
46.9	39.5	31.3

Capillary Pressure vs Water Saturation

Company: BHPP
Well: Minerva 2A
Sample: 104



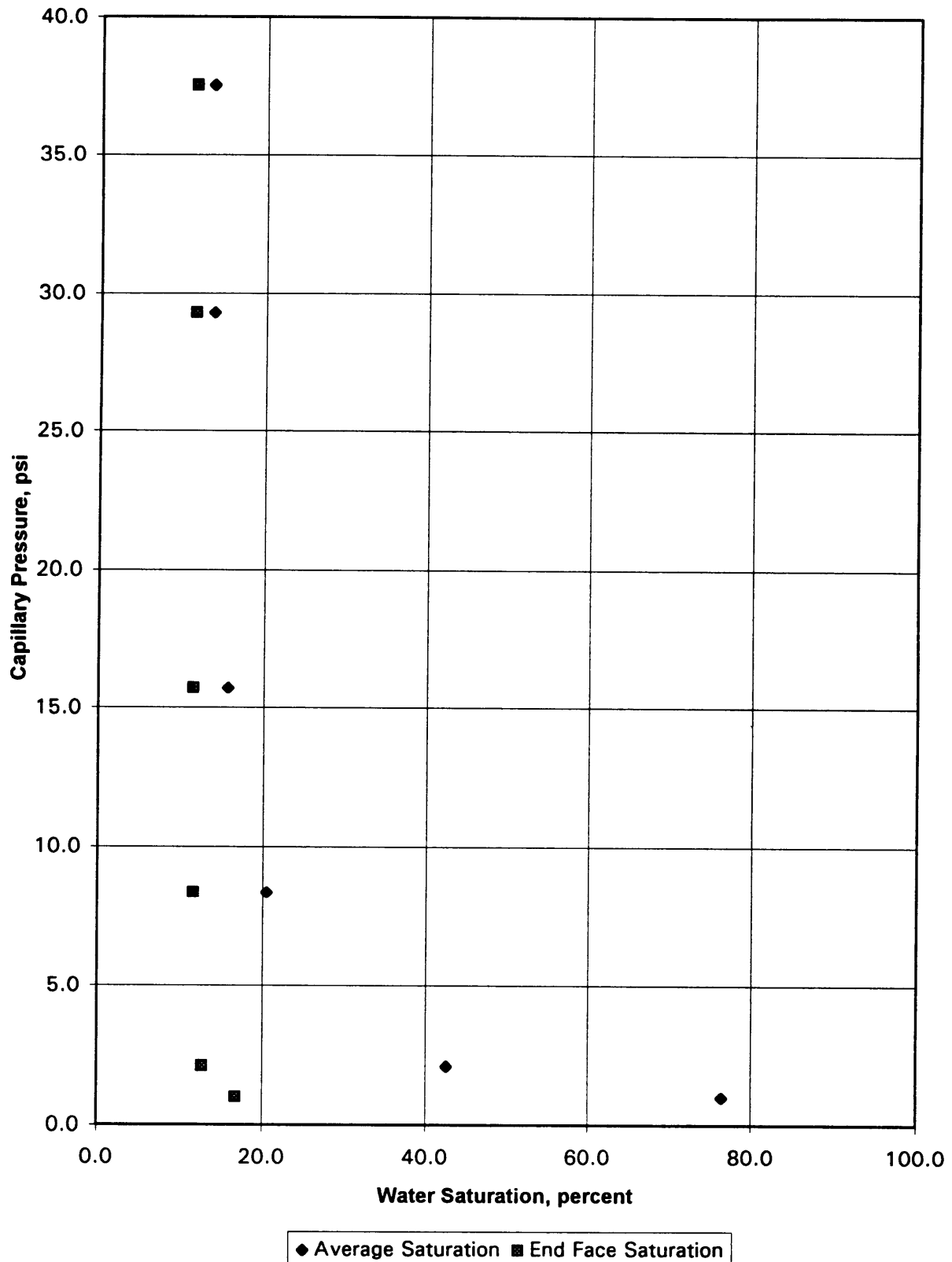
CAPILLARY PRESSURE

Company	BHP Petroleum Pty Ltd	Phase: 1a
Well	Minerva 2A	
Test Method	Centrifuge: Air/Brine Drainage	
Sample Number	105	
Depth	1865.70	metres
Permeability to Air	3058	millidarcys
Porosity	24.7	percent
Ambient		

Capillary Pressure (psi)	Average Saturation, percent	End-Face Saturation, percent
1.0	76.5	16.8
2.1	42.6	12.7
8.3	20.5	11.6
15.7	15.7	11.5
29.3	13.7	11.5
37.5	13.6	11.5

Capillary Pressure vs Water Saturation

Company: BHPP
Well: Minerva 2A
Sample: 105



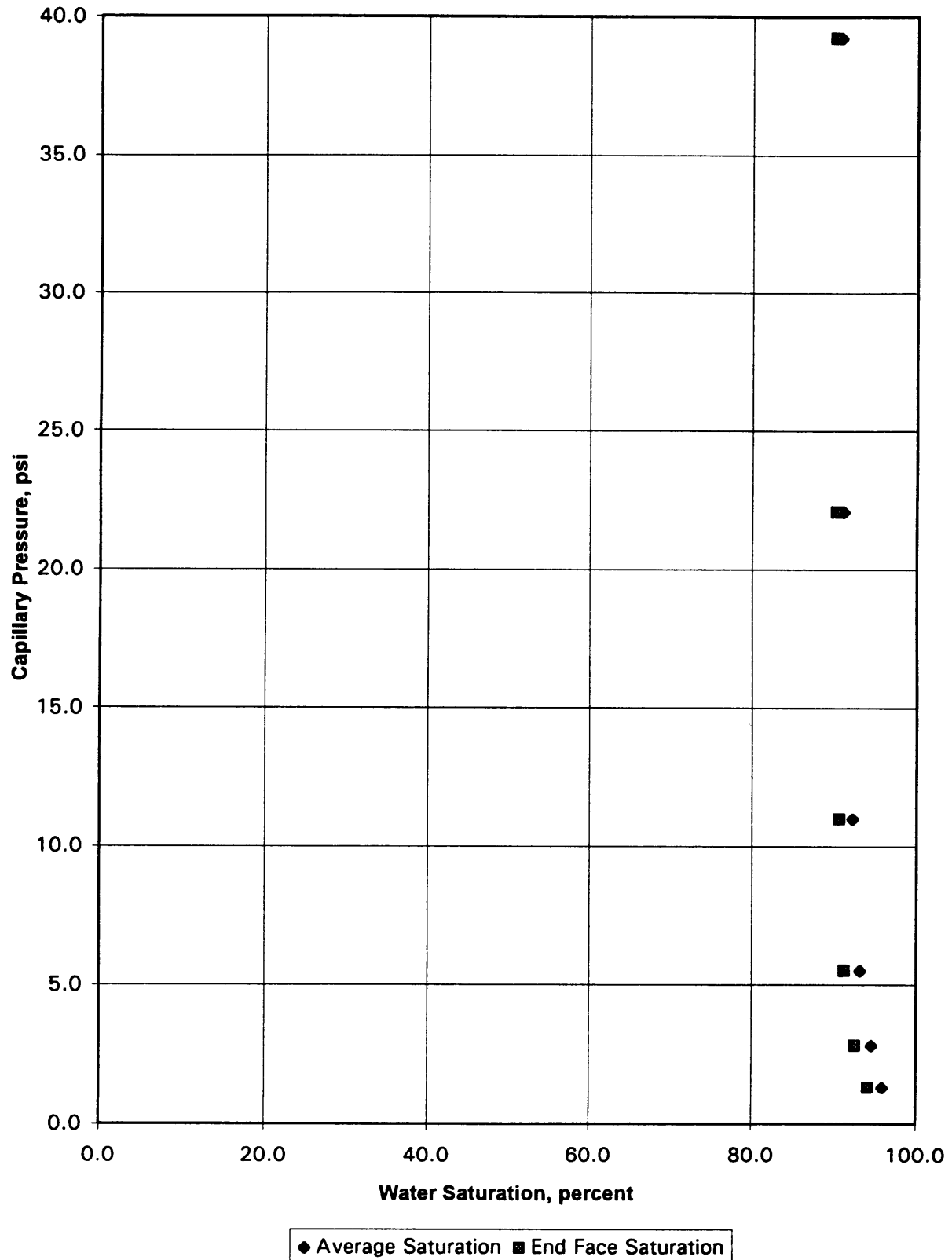
CAPILLARY PRESSURE

Company	BHP Petroleum Pty Ltd	Phase: 1a
Well	Minerva 2A	
Test Method	Centrifuge: Air/Brine Drainage	
Sample Number	108	
Depth	1866.60	metres
Permeability to Air	1.95	millidarcys
Porosity	9.4	percent
Ambient		

Capillary Pressure (psi)	Average Saturation, percent	End-Face Saturation, percent
1.3	95.9	94.2
2.8	94.6	92.6
5.5	93.2	91.3
11.0	92.3	90.7
22.1	91.2	90.3
39.2	90.8	90.1

Capillary Pressure vs Water Saturation

Company: BHPP
Well: Minerva 2A
Sample: 108



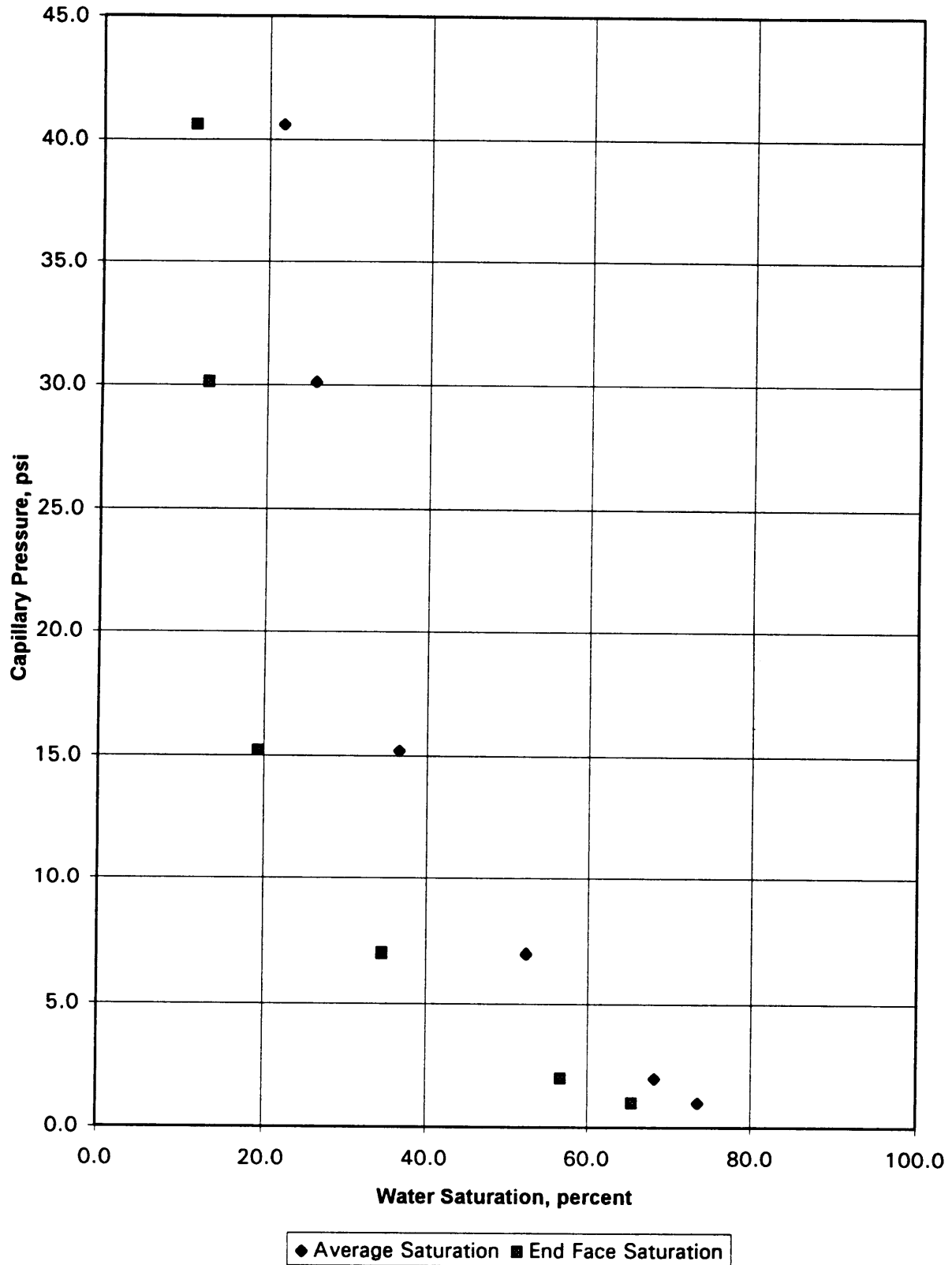
CAPILLARY PRESSURE

Company	BHP Petroleum Pty Ltd	Phase: 1a
Well	Minerva 2A	
Test Method	Centrifuge: Air/Brine Drainage	
Sample Number	111	
Depth	1867.53	metres
Permeability to Air	136	millidarcys
Porosity	19.9	percent
Ambient		

Capillary Pressure (psi)	Average Saturation, percent	End-Face Saturation, percent
1.0	73.6	65.5
2.0	68.3	56.7
7.0	52.4	34.6
15.2	36.6	19.3
30.1	26.0	12.9
40.6	21.8	11.2

Capillary Pressure vs Water Saturation

Company: BHPP
Well: Minerva 2A
Sample: 111



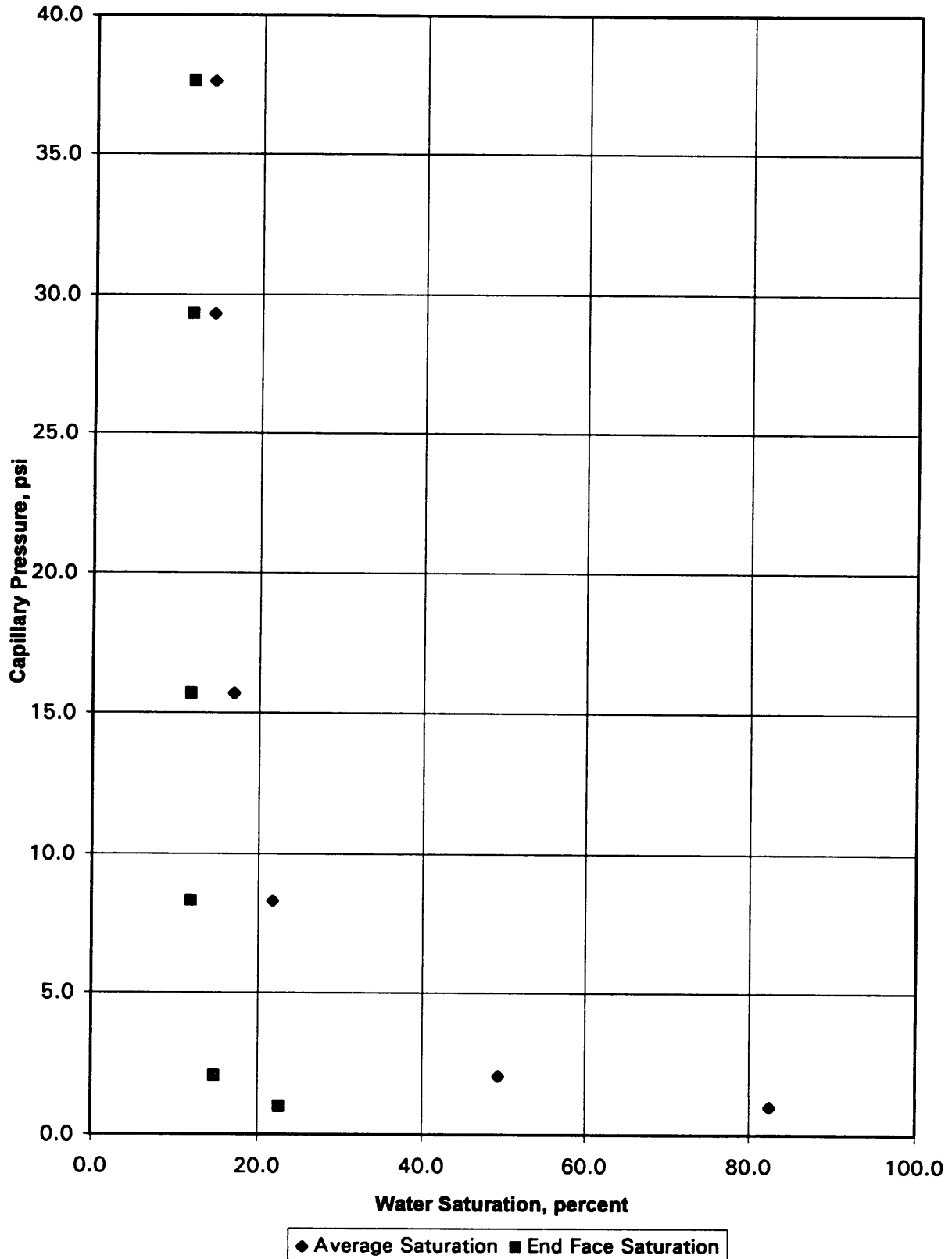
CAPILLARY PRESSURE

Company	BHP Petroleum Pty Ltd	Phase: 1a
Well	Minerva	
Test Method	Centrifuge: Air/Brine Drainage	
Sample Number	117	
Depth	1869.30	metres
Permeability to Air	2028	millidarcys
Porosity	25.8	percent
Ambient		

Capillary Pressure (psi)	Average Saturation, percent	End-Face Saturation, percent
1.0	82.5	22.6
2.1	49.4	14.8
8.3	21.8	11.9
15.7	17.0	11.8
29.3	14.3	11.7
37.6	14.2	11.7

Capillary Pressure vs Water Saturation

Company: BHPP
Well: Minerva 2A
Sample: 117



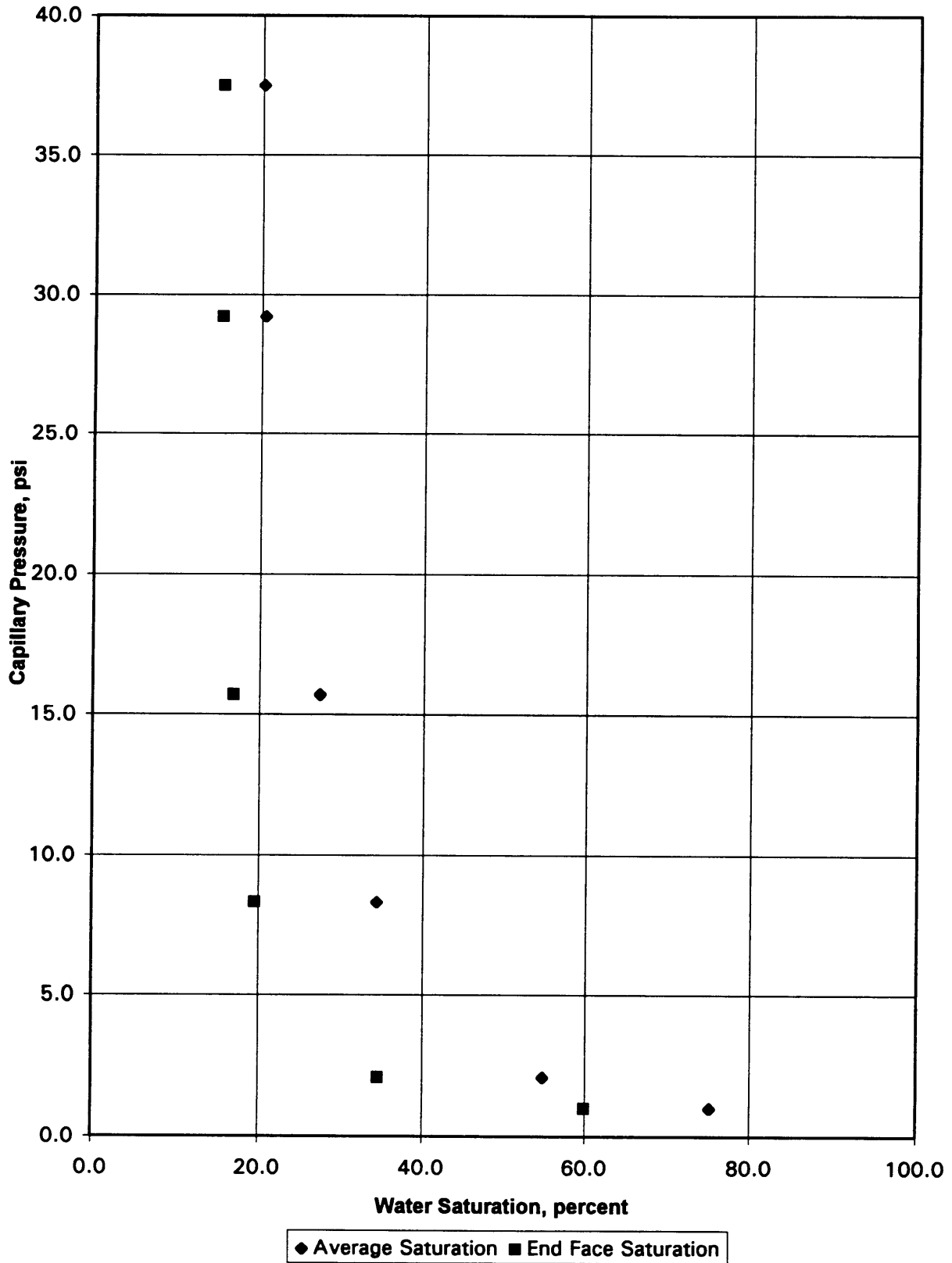
CAPILLARY PRESSURE

Company	BHP Petroleum Pty Ltd	Phase: 1a
Well	Minerva	
Test Method	Centrifuge: Air/Brine Drainage	
Sample Number	158	
Depth	1881.60	metres
Permeability to Air	2230	millidarcys
Porosity	21.5	percent
Ambient		

Capillary Pressure (psi)	Average Saturation, percent	End-Face Saturation, percent
1.0	75.2	59.9
2.1	54.8	34.6
8.3	34.4	19.6
15.7	27.4	16.9
29.2	20.5	15.3
37.5	20.2	15.3

Capillary Pressure vs Water Saturation

Company: BHPP
Well: Minerva 2A
Sample: 158



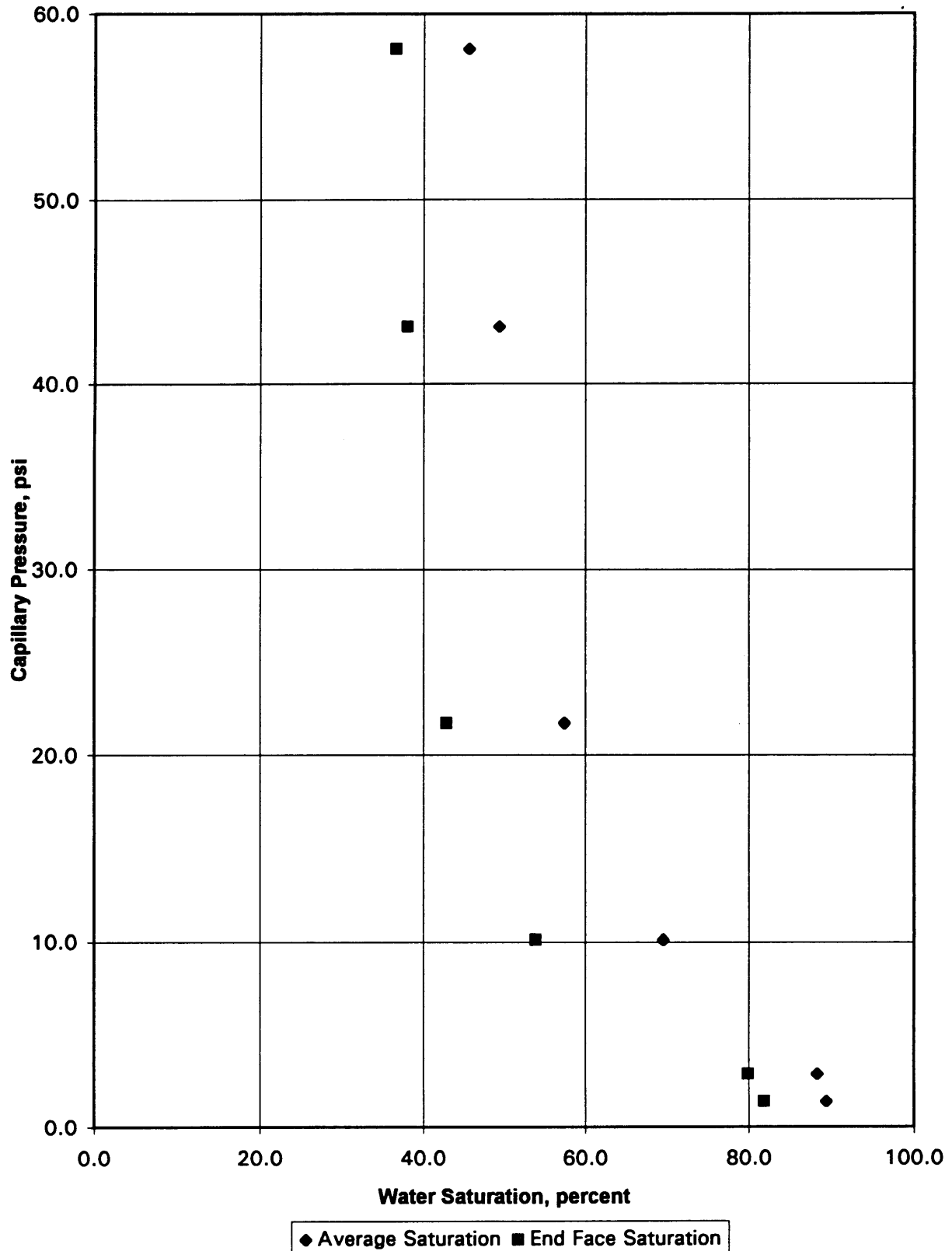
CAPILLARY PRESSURE

Company	BHP Petroleum Pty Ltd	Phase: 1a
Well	Minerva	
Test Method	Centrifuge: Air/Brine Drainage	
Sample Number	161	
Depth	1882.50	metres
Permeability to Air	376	millidarcys
Porosity	17.2	percent
Ambient		

Capillary Pressure (psi)	Average Saturation, percent	End-Face Saturation, percent
1.4	89.4	81.9
2.9	88.3	79.9
10.1	69.6	53.9
21.7	57.4	42.9
43.1	49.4	38.1
58.2	45.6	36.6

Capillary Pressure vs Water Saturation

Company: BHPP
Well: Minerva 2A
Sample: 161



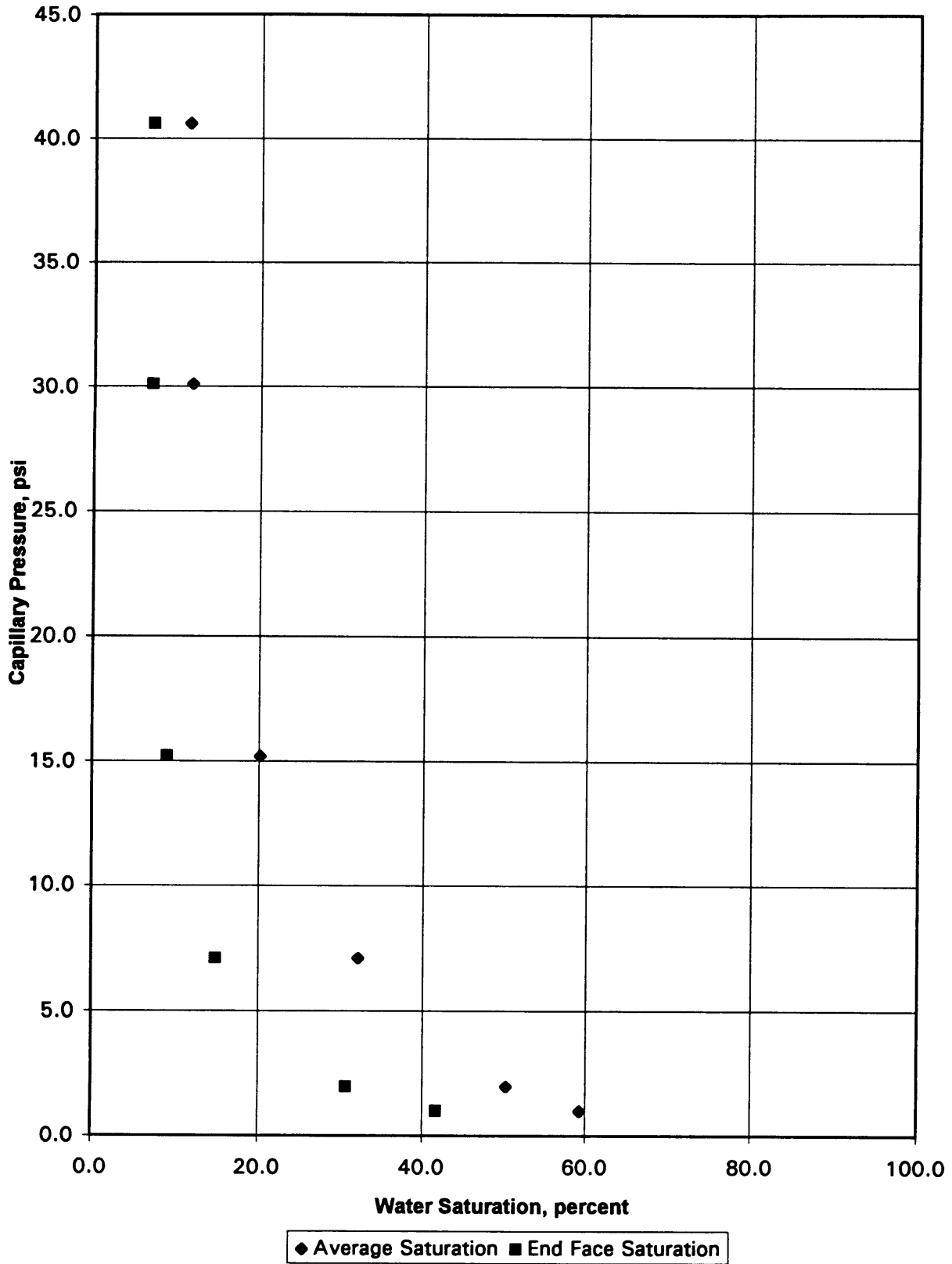
CAPILLARY PRESSURE

Company	BHP Petroleum Pty Ltd	Phase: 1a
Well	Minerva	
Test Method	Centrifuge: Air/Brine Drainage	
Sample Number	163	
Depth	1915.30	metres
Permeability to Air	968	millidarcys
Porosity	19.8	percent
Ambient		

	Capillary Pressure (psi)	Average Saturation, percent	End-Face Saturation, percent
	1.0	59.3	41.7
	2.0	50.3	30.7
	7.0	32.2	14.9
	15.2	20.2	9.0
	30.1	11.8	7.0
	40.6	11.4	7.0

Capillary Pressure vs Water Saturation

Company: BHPP
Well: Minerva 2A
Sample: 163



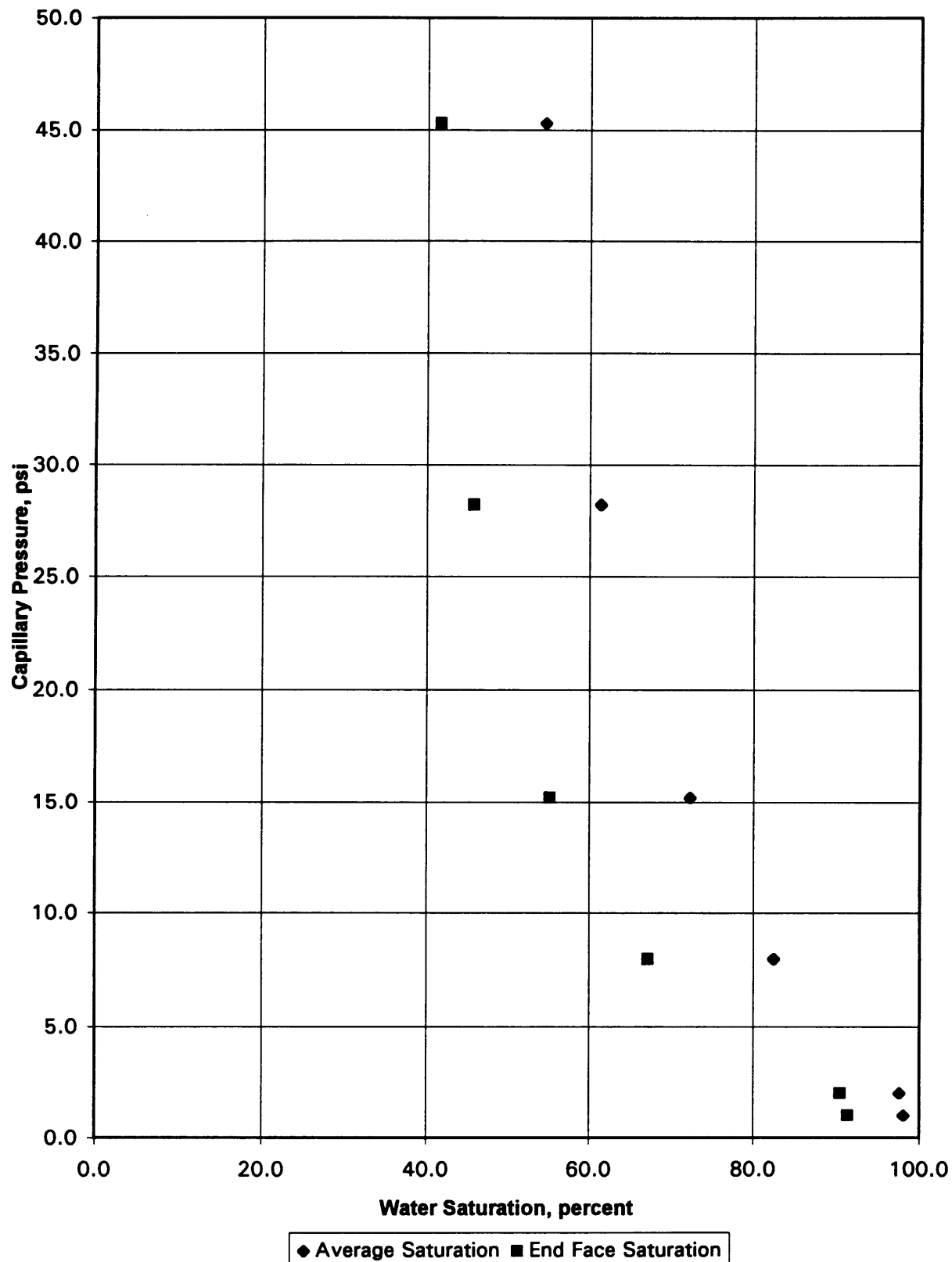
CAPILLARY PRESSURE

Company BHP Petroleum Pty Ltd **Phase: 1a**
Well Minerva
Test Method Centrifuge: Air/Brine Drainage
Sample Number 216
Depth 1931.20 metres
Permeability to Air 18.5 millidarcys
Porosity 18.0 percent
Ambient

Capillary Pressure (psi)	Average Saturation, percent	End-Face Saturation, percent
1.0	98.1	91.4
2.0	97.6	90.5
8.0	82.5	67.2
15.2	72.3	55.2
28.2	61.4	45.8
45.3	54.5	41.6

Capillary Pressure vs Water Saturation

Company: BHPP
Well: Minerva 2A
Sample: 216



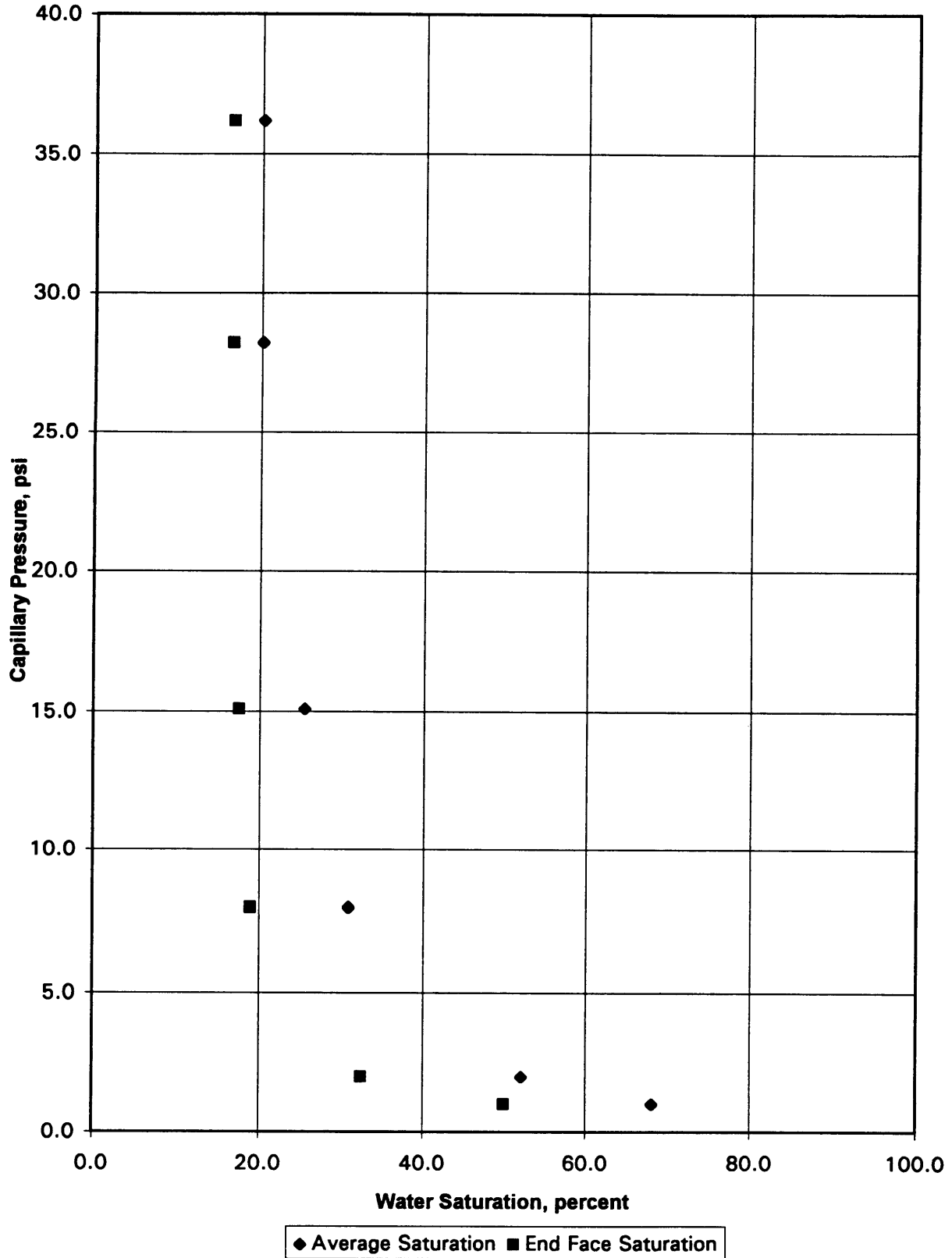
CAPILLARY PRESSURE

Company	BHP Petroleum Pty Ltd	Phase: 1a
Well	Minerva 2A	
Test Method	Centrifuge: Air/Brine Drainage	
Sample Number	219	
Depth	1932.10	metres
Permeability to Air	2736	millidarcys
Porosity	16.9	percent
Ambient		

Capillary Pressure (psi)	Average Saturation, percent	End-Face Saturation, percent
1.0	68.1	50.0
2.0	52.1	32.5
8.0	30.9	19.0
15.1	25.5	17.5
28.2	20.2	16.6
36.2	20.2	16.6

Capillary Pressure vs Water Saturation

Company: BHPP
Well: Minerva 2A
Sample: 219



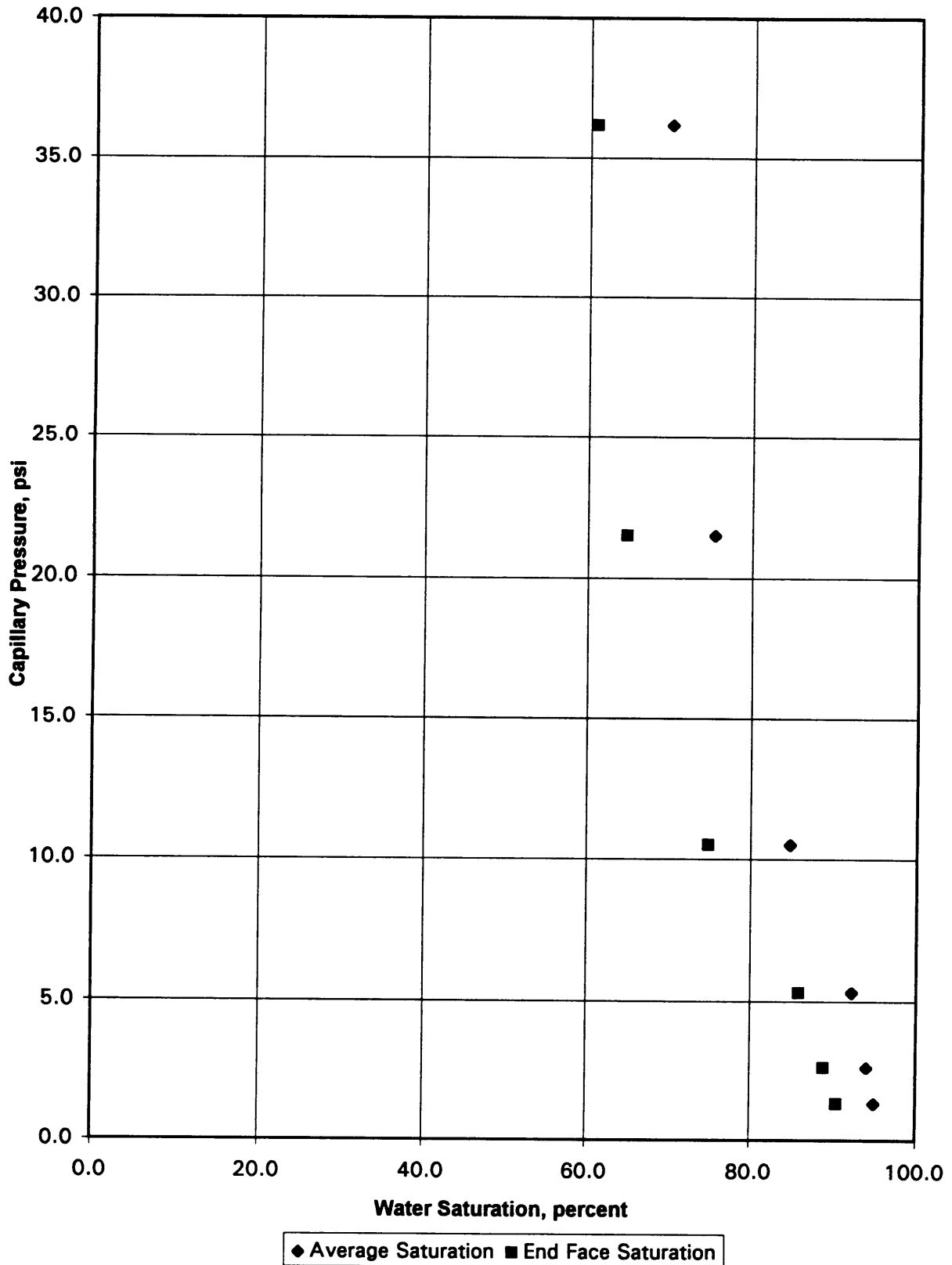
CAPILLARY PRESSURE

Company	BHP Petroleum Pty Ltd	Phase: 1a
Well	Minerva 2A	
Test Method	Centrifuge: Air/Brine Drainage	
Sample Number	220	
Depth	1932.40	metres
Permeability to Air	4.46	millidarcys
Porosity	16.4	percent
Ambient		

	Capillary Pressure (psi)	Average Saturation, percent	End-Face Saturation, percent
	1.3	95.0	90.5
	2.6	94.1	88.9
	5.3	92.3	85.9
	10.5	84.8	74.9
	21.5	75.5	64.8
	36.2	70.0	60.8

Capillary Pressure vs Water Saturation

Company: BHPP
Well: Minerva 2A
Sample: 220



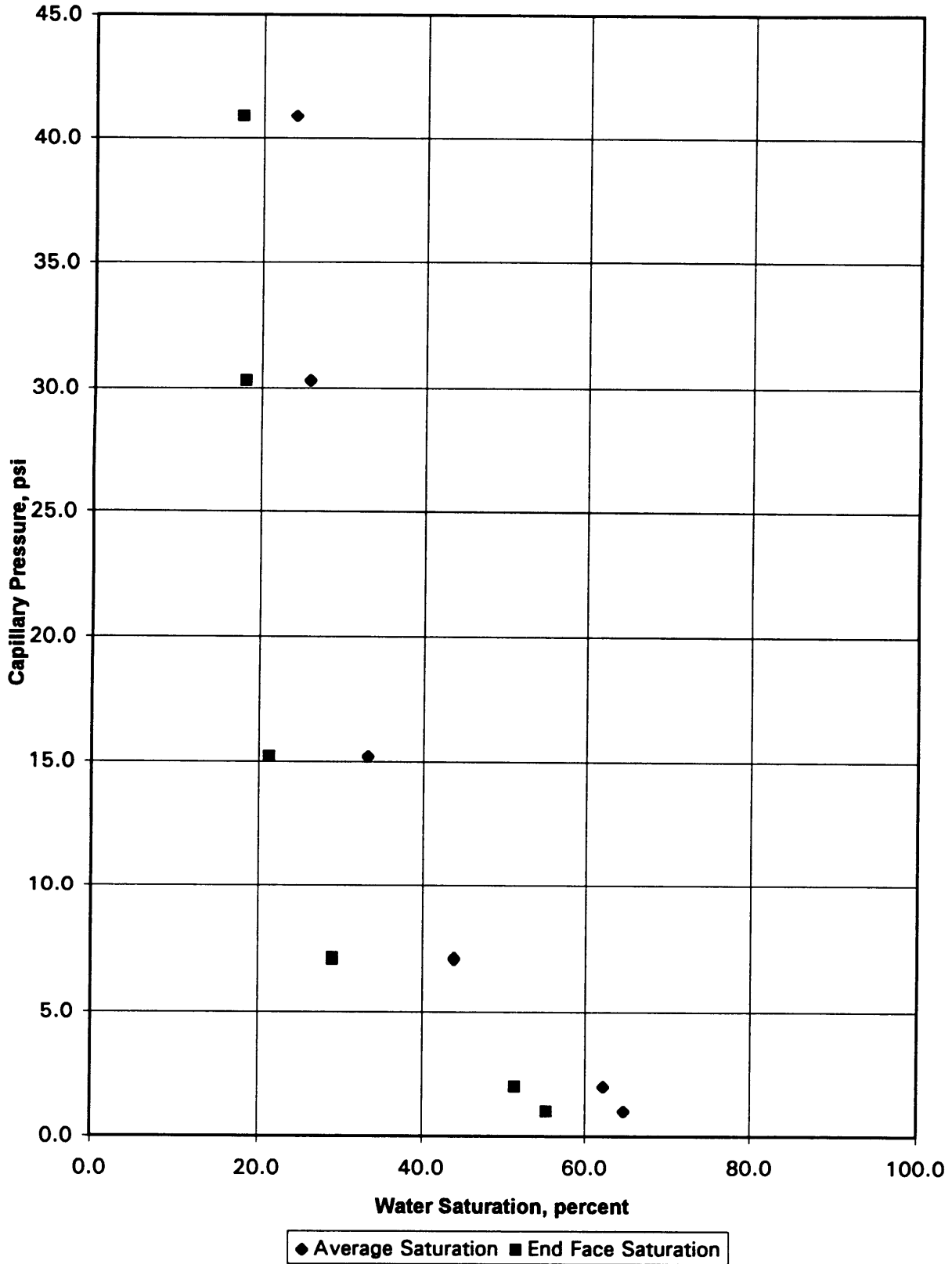
CAPILLARY PRESSURE

Company	BHP Petroleum Pty Ltd	Phase: 1a
Well	Minerva 2A	
Test Method	Centrifuge: Air/Brine Drainage	
Sample Number	334	
Depth	1966.70	metres
Permeability to Air	668	millidarcys
Porosity	17.1	percent
Ambient		

Capillary Pressure (psi)	Average Saturation, percent	End-Face Saturation, percent
1.0	64.7	55.3
2.0	62.2	51.4
7.1	43.9	29.1
15.2	33.3	21.3
30.3	25.9	18.1
40.9	24.0	17.6

Capillary Pressure vs Water Saturation

Company: BHPP
Well: Minerva 2A
Sample: 334



EFFECTIVE GAS PERMEABILITY
(As a function of Brine Saturation)

Company BHP Petroleum Pty Ltd **Phase: 1ai**
Well Minerva-2A

Ambient Pressure 200 psi

Sample Number	Depth, metres	Ambient Permeability to Air, millidarcys	Ambient Porosity, percent	Ambient Water Saturation, percent	Effective Permeability to Gas, millidarcys
27	1841.70	15007	16.6	11.0	14670
31	1842.90	5981	21.2	22.2	6005
38	1845.00	13913	20.5	25.9	13710
53	1849.50	1891	15.9	18.7	827
69	1854.30	7573	17.1	5.5	3464
77	1857.30	348	13.9	35.8	207
104	1865.40	63.3	19.5	39.5	35.3
105	1865.70	3058	24.7	13.6	3075
108	1866.60	1.95	9.4	90.8	0.13
111	1867.53	136	19.9	21.8	117
117	1869.30	2028	25.8	14.2	2070
158	1881.60	2230	21.5	20.2	2092
161	1882.50	376	17.2	45.6	267
163	1915.30	968	19.8	11.4	640
216	1931.20	18.5	18.0	54.5	10.4
219	1932.10	2736	16.9	20.2	2619
220	1932.40	4.46	16.4	70.0	0.86
334	1966.70	668	17.1	24.0	426

EFFECTIVE GAS PERMEABILITY
(As a function of Brine Saturation)

**Company
Well**

BHP Petroleum Pty Ltd
Minerva-2A

Phase: 1bi & 1bii

Ambient Pressure

200 psi

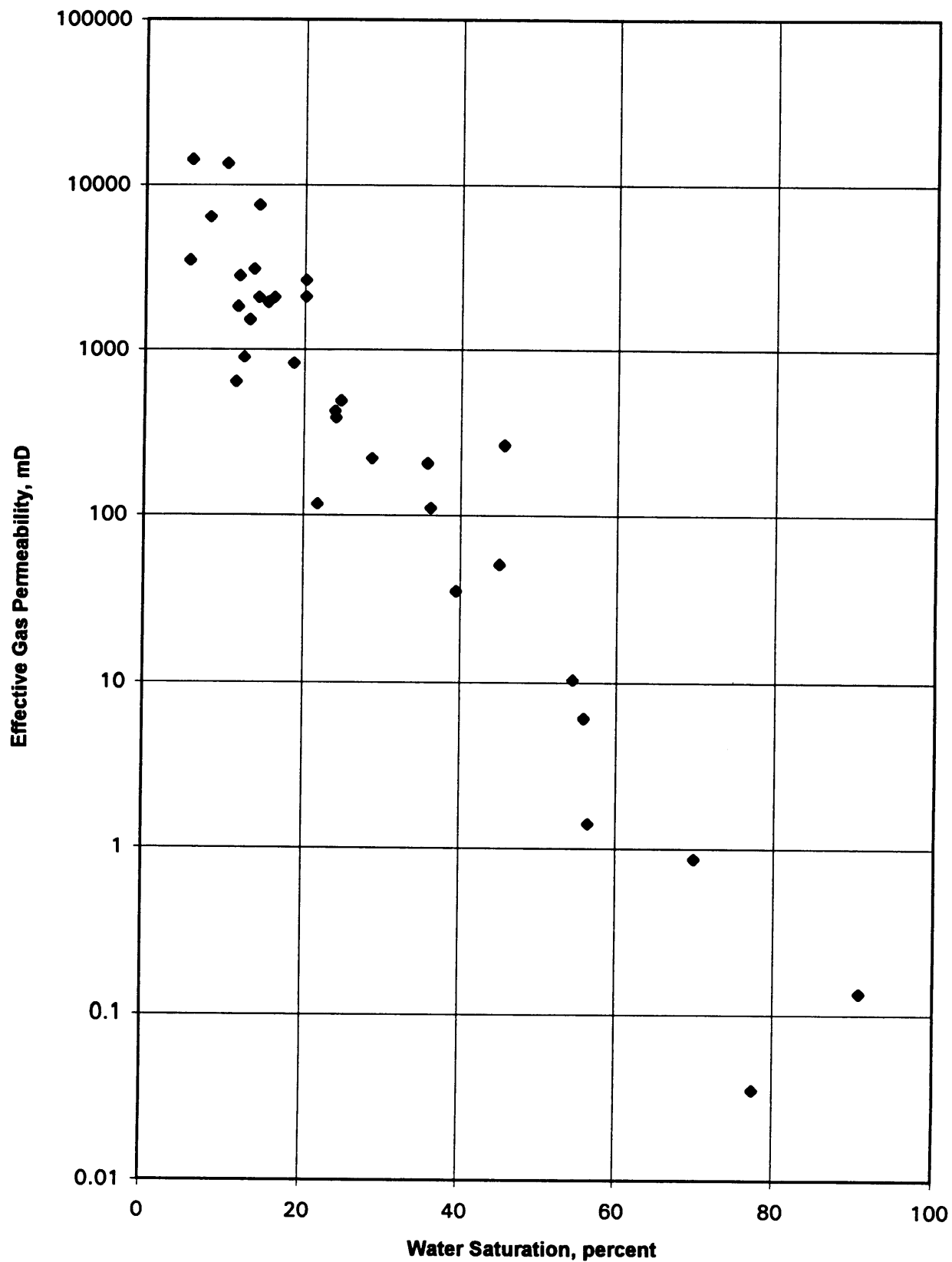
Sample Number	Depth	Permeability to Air, millidarcys	Porosity, (percent)	Water Saturation, (percent)	Permeability to Gas, millidarcys
43	1846.50	513	17.3	24.7	492
49	1848.30	7586	17.3	14.2	7503
50	1848.60	13515	19.8	10.2	13469
61	1851.90	14241	16.8	5.8	14261
80	1858.20	2415	16.1	16.2	2065
118	1869.60	1878	25.4	11.6	1821
122	1870.80	2887	25.8	11.8	2791
142	1876.80	129	18.4	36.2	111
153	1880.10	6441	21.9	8.1	6357
172	1918.00	74	19.4	45.0	51
225	1933.90	394	14.7	24.1	389
230	1935.40	3.9	15.1	56.5	1.4
266	1946.30	237	18.1	28.7	222
273	1948.40	1.7	12.4	77.5	0.035
283	1951.40	958	20.3	12.4	898
306	1958.30	12	16.8	55.9	6.1
312	1960.10	1975	19.4	15.4	1941
341	1968.80	1773	16.2	13.1	1511

Effective Gas Permeability

Company: BHP Petroleum

Well: Minerva 2A

Ambient



EFFECTIVE GAS PERMEABILITY
(As a function of Brine Saturation)

Company BHP Petroleum Pty Ltd **Phase: 1ai**
Well Minerva 2A

Overburden Pressure 2100 psi

Sample Number	Depth, metres	Permeability to Air, millidarcys	Porosity, percent	Ambient Water Saturation, percent	Effective Permeability to Gas, millidarcys
27	1841.70			11.0	6197
31	1842.90			22.2	3288
38	1845.00			25.9	6474
53	1849.50	1635	15.2	18.7	772
69	1854.30			5.5	2043
77	1857.30			35.8	173
104	1865.40	57.1	18.6	39.5	33.8
105	1865.70			13.6	1922
108	1866.60			90.8	0.13
111	1867.53			21.8	70.8
117	1869.30			14.2	739
158	1881.60			20.2	1483
161	1882.50	311	16.2	45.6	234
163	1915.30			11.4	598
216	1931.20			54.5	9.0
219	1932.10	2471	15.9	20.2	2177
220	1932.40			70.0	0.48
334	1966.70			24.0	398

**EFFECTIVE PERMEABILITY TO BRINE
@ RESIDUAL GAS SATURATIONS**

Company BHP Petroleum Pty Ltd **Phase: 2a & 2bi**
Well Minerva 2A **and, Phase: 2ai & 2bii**

Test Method Ambient Air/Brine Imbibition Centrifuge
Overburden Pressure 2100 psi

Sample Number	Depth, metres	Ambient Permeability to Air, milliDarcy's	Ambient Porosity, percent	Residual Ambient Gas Saturation, percent	Effective Permeability to Brine @ Sgr, milliDarcy's
27	1841.70	15007	16.6	36.9	3570
31	1842.90	5981	21.2	19.7	2062
38	1845.00	13913	20.5	12.6	2672
43	1846.50	513	17.3	30.0	54
49	1848.30	7586	17.3	30.9	600
50	1848.60	13515	19.8	34.5	916
53	1849.50	1891	15.9	39.9	231
61	1851.90	14241	16.8	27.8	1429
69	1854.30	7573	17.1	33.6	848
77	1857.30	348	13.9	50.0	66
80	1858.20	2415	16.1	29.6	238
104	1865.40	63	19.5	5.6	22
105	1865.70	3058	24.7	23.5	851
108	1866.60	1.95	9.4	4.0	0.03
111	1867.53	136	19.9	15.9	32.3
117	1869.30	2028	25.8	31.5	257
118	1869.60	1878	25.4	21.0	516
122	1870.80	2887	25.8	13.0	837
142	1876.80	129	18.4	11.0	47
153	1880.10	6441	21.9	23.7	1045
158	1881.60	2230	21.5	22.4	523
161	1882.50	376	17.2	40.5	64
163	1915.30	968	19.8	32.0	216
172	1918.00	74	19.4	19.4	34.7

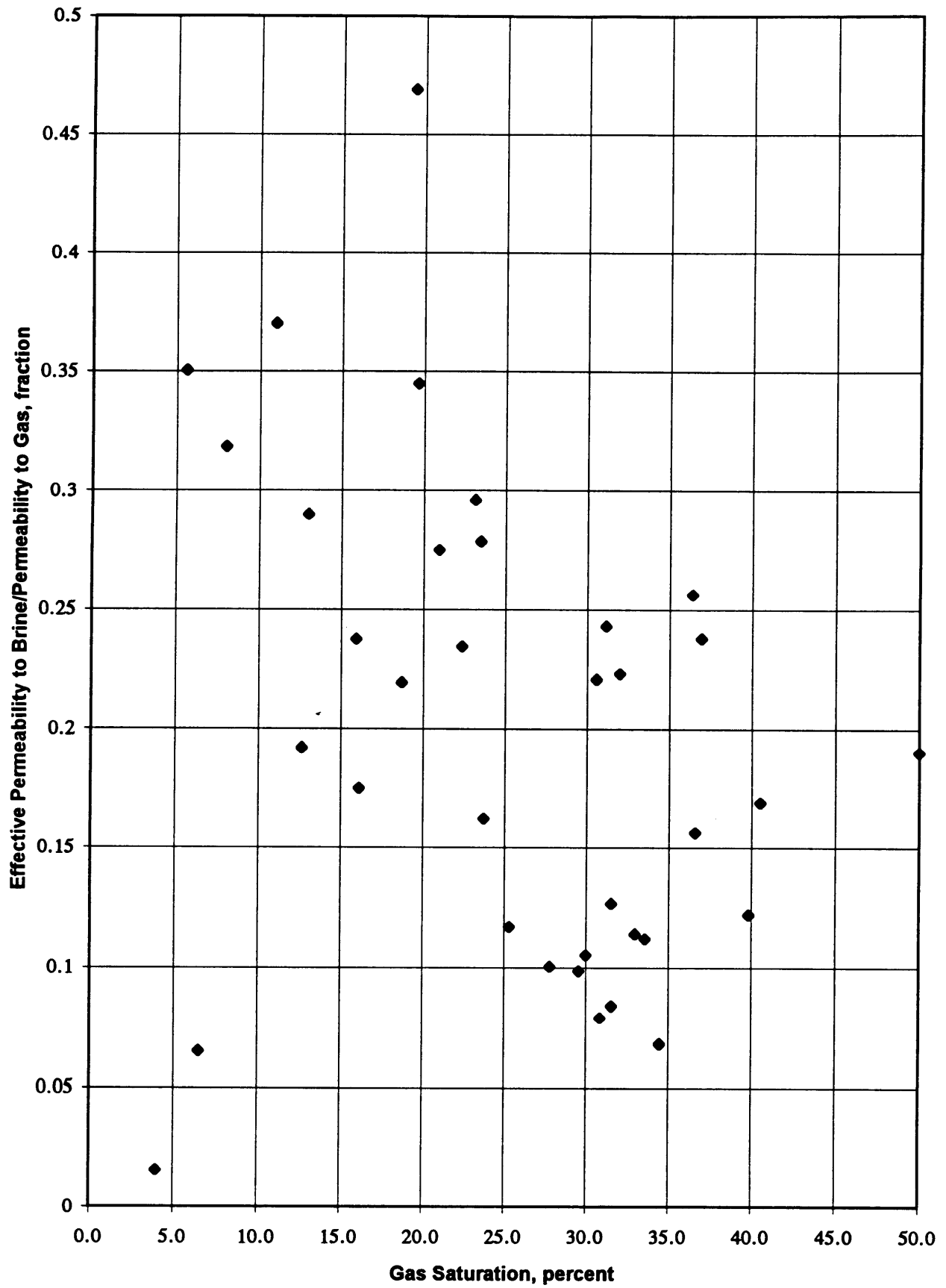
**EFFECTIVE PERMEABILITY TO BRINE
@ RESIDUAL GAS SATURATIONS**

Company BHP Petroleum Pty Ltd **Phase: 2a & 2bi**
Well Minerva 2A **and, Phase: 2ai & 2bii**

Test Method Ambient Air/Brine Imbibition Centrifuge
Overburden Pressure 2100 psi

Sample Number	Depth, metres	Ambient Permeability to Air, milliDarcy's	Ambient Porosity, percent	Residual Ambient Gas Saturation, percent	Effective Permeability to Brine @ Sgr, milliDarcy's
216	1931.20	18.5	18.0	8.0	5.89
219	1932.10	2736	16.9	36.4	701
220	1932.40	4.46	16.4	23.1	1.32
225	1933.90	394	14.7	30.6	87
230	1935.40	3.9	15.1	36.6	0.61
266	1946.30	237	18.1	18.7	52
273	1948.40	1.7	12.4	6.5	0.11
283	1851.40	958	20.3	25.3	112
306	1958.30	12	16.8	16.1	2.1
312	1960.10	1975	19.4	31.2	480
334	1966.70	668	17.1	31.6	56
341	1968.80	1773	16.2	33.0	202

Effective Brine Permeability



CONNATE WATER SATURATION

**Company
Well**

BHP Petroleum Pty Ltd
Minerva 2A

Phase: 2c

**Test Method
Ambient**

Air/Brine Centrifuge Drainage

Sample Number	Depth, metres	Permeability to Air, milliDarcy's	Porosity, percent	Water Saturation, percent
43	1846.50	513	17.3	30.5
61	1851.90	14241	16.8	10.1
153	1880.10	6441	21.9	8.8
266	1946.30	237	18.1	36.1
306	1958.30	12	16.8	67.7

RESIDUAL GAS SATURATION

Company BHP Petroleum Pty Ltd **Phase: 2d**
Well Minerva 2A
Test Method Air/Brine Centrifuge Imbibition
Ambient

Sample Number	Depth, metres	Permeability to Air, milliDarcy's	Porosity, percent	Residual Gas Saturation, percent
43	1846.50	513	17.3	26.4
61	1851.90	14241	16.8	19.2
153	1880.10	6441	21.9	20.4
266	1946.30	237	18.1	25.5
306	1958.30	12	16.8	15.7

BASIC WATERFLOOD

Company Well BHP Petroleum Pty Ltd Minerva 2A **Phase: 4ai, 4aii**

Test Methods Initial Water Saturation - Air/Brine Porous Plate Drainage @ 70 psi
Terminal Conditions - Overburden Waterflood

Overburden Pressure 2100 psi

Sample Number	Depth, metres	INITIAL CONDITIONS				TERMINAL CONDITIONS			
		Ambient Permeability to air, milliDarcy's	Ambient Porosity, percent	$P/P_{Ambient}$ Water Saturation, percent	Effective Permeability to Gas, milliDarcy's	Effective Permeability to Brine, milliDarcy's	Residual Gas Saturation, percent	Gas Recovered Percent Pore Space	Gas in Place Percent
50	1848.60	13515	19.8	13.7	10558	3390	29.0	57.3	66.4
80	1858.20	2415	16.1	15.7	1814	798	26.1	58.2	69.0
122	1870.80	2887	25.8	8.9	2704	659	28.5	62.6	68.7
142	1876.80	129	18.4	28.0	103	29.9	22.6	49.4	68.6
230	1935.40	3.9	15.1	44.1	1.8	0.52	8.8	47.1	84.3
283	1951.40	958	20.3	13.6	748	74	33.6	52.8	61.1

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RESIDUAL GAS SATURATION

**Company
Well**

BHP Petroleum Pty Ltd
Minerva 2A

Phase: 4b

**Test Method
Ambient**

Air/Brine Centrifuge Imbibition (following Waterflood)

Sample Number	Depth, metres	Permeability to Air, milliDarcy's	Porosity, percent	Residual Gas Saturation, percent
50	1848.60	13515	19.8	16.5
80	1858.20	2415	16.1	17.2
122	1870.80	2887	25.8	19.5
142	1876.80	129	18.4	12.2
230	1935.40	3.9	15.1	8.8
283	1951.40	958	20.3	16.0

CAPILLARY PRESSURE

Company	BHP Petroleum Pty Ltd	Phase: 1c
Well	Minerva 2A	
Test Method	Air/Mercury Capillary Pressure	
Sample Number	31	
Depth	1842.90 metres	

Pressure (psia)	Intrusion percent	Saturation percent	Pore Diameter (μm)
1.93	0.0	0.0	55
2.47	1.4	1.7	43
2.92	11.3	15.3	36
3.47	9.1	26.3	31
4.13	6.1	33.7	26
4.91	4.5	39.1	22
5.86	3.4	43.2	18
6.98	2.4	46.1	15
8.34	2.0	48.5	13
9.94	1.6	50.4	11
11.9	1.7	52.5	8.9
14.2	1.4	54.2	7.5
16.9	1.6	56.1	6.3
20.2	1.3	57.6	5.2
24.2	1.4	59.3	4.4
28.9	1.6	61.2	3.7
34.5	1.4	62.9	3.1
41.3	1.4	64.6	2.6
49.2	1.6	66.5	2.2
58.7	1.6	68.4	1.8
70.3	1.6	70.3	1.5
83.7	1.7	72.3	1.3
99.6	1.6	74.2	1.1
119	1.8	76.4	0.89
142	1.6	78.3	0.75
169	1.8	80.5	0.63

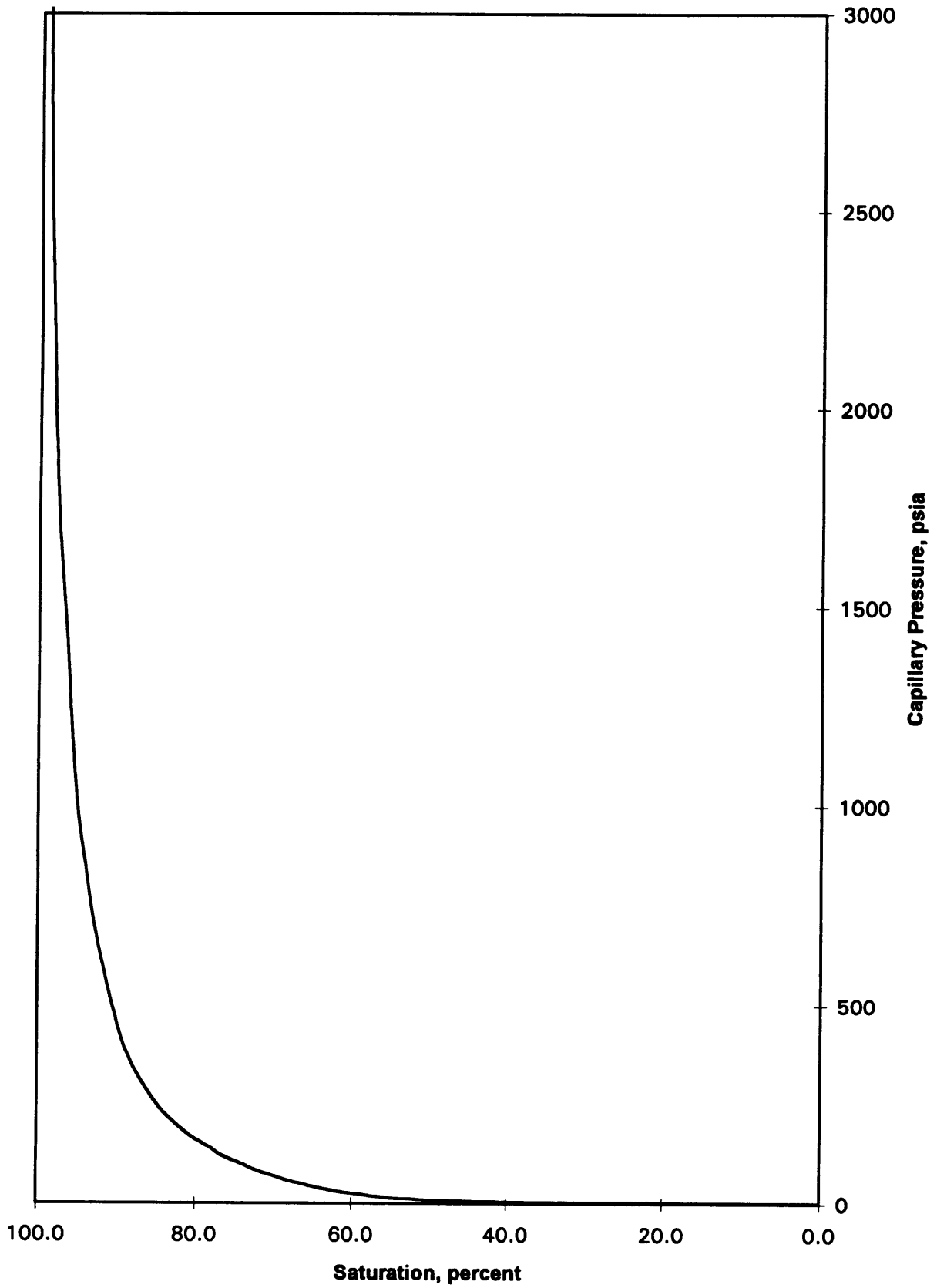
Pressure (psia)	Intrusion percent	Saturation percent	Pore Diameter (μm)
203	1.7	82.6	0.52
240	1.6	84.5	0.44
288	1.4	86.2	0.37
344	1.4	87.9	0.31
409	1.1	89.3	0.26
495	1.0	90.5	0.21
593	1.0	91.7	0.18
701	1.0	92.9	0.15
836	0.8	93.9	0.13
1009	1.0	95.1	0.11
1196	0.6	95.8	0.089
1431	0.6	96.4	0.074
1711	0.8	97.5	0.062
2047	0.6	98.2	0.052
2448	0.4	98.7	0.043
2927	0.3	99.0	0.036
3515	0.1	99.2	0.030
4178	0.3	99.5	0.025
5024	0.1	99.7	0.021
6005	0.1	99.9	0.018
7155	0.0	99.9	0.015
8573	0.0	99.9	0.012
10235	0.0	99.9	0.010
12229	0.0	99.9	0.009
14620	0.0	99.9	0.007
17485	0.0	99.9	0.006
20924	0.0	99.9	0.005
25012	0.0	99.9	0.004
29870	0.0	99.9	0.004
35698	0.1	100.0	0.003
39634	0.0	100.0	0.003

Capillary Pressure Vs Saturation

Client: BHP Petroleum

Well: Minerva 2A

Sample: 31

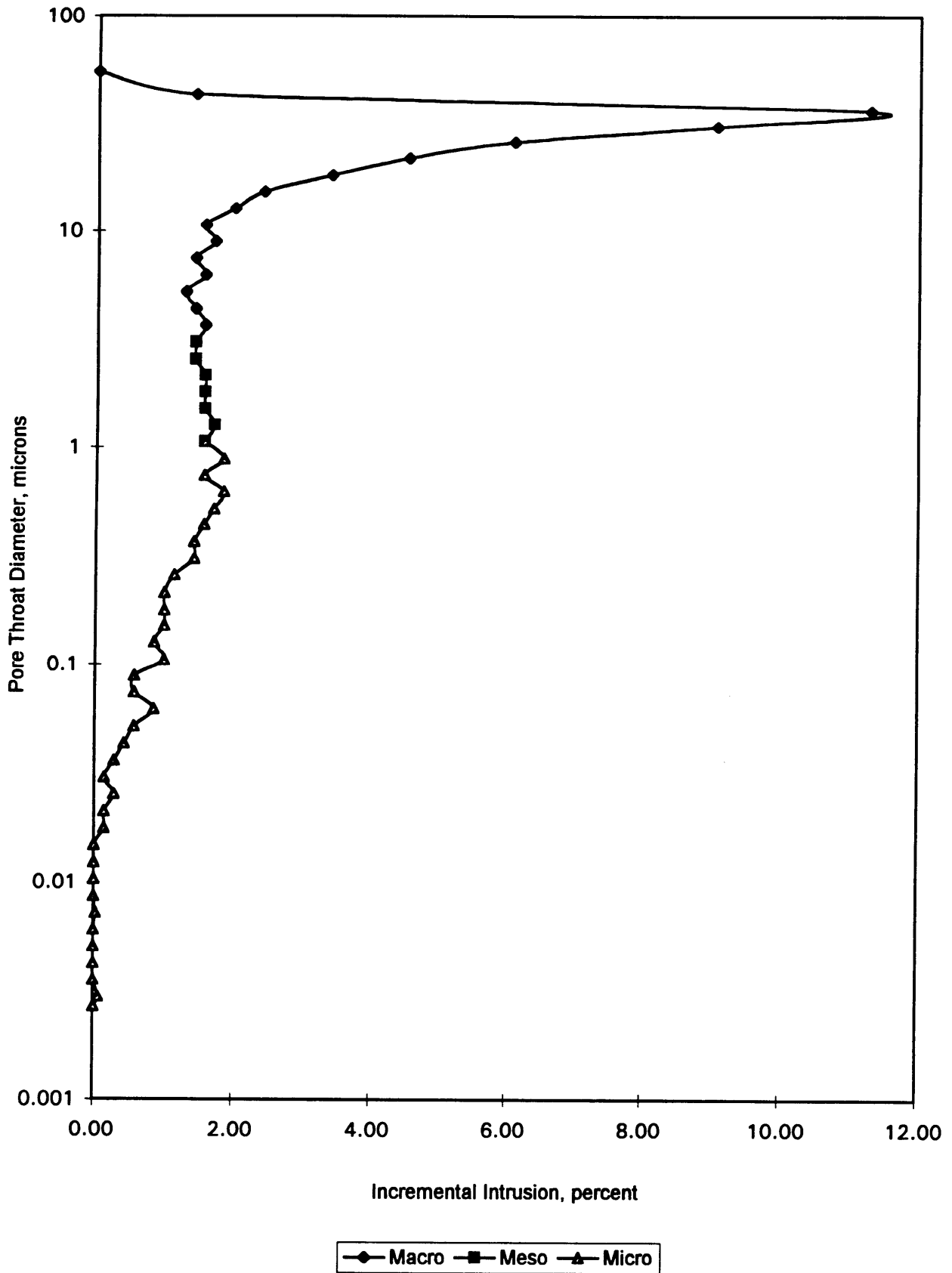


Pore Throat Diameter Vs Incremental Intrusion

Client: BHP Petroleum

Well: Minerva 2A

Sample: 31



CAPILLARY PRESSURE

Company	BHP Petroleum Pty Ltd	Phase: 1c
Well	Minerva 2A	
Test Method	Air/Mercury Capillary Pressure	
Sample Number	38	
Depth	1845.00 metres	

Pressure (psia)	Intrusion percent	Saturation percent	Pore Diameter (μm)
1.93	0.0	0.0	55
2.45	3.6	3.6	43
2.92	9.9	13.5	36
3.46	8.4	21.9	31
4.13	5.1	27.0	26
4.91	4.5	31.5	22
5.85	3.3	34.8	18
6.98	3.0	37.8	15
8.33	3.0	40.8	13
9.94	2.4	43.2	11
11.9	2.4	45.6	8.9
14.2	2.7	48.3	7.5
16.9	2.7	51.0	6.3
20.2	2.8	53.8	5.2
24.1	3.0	56.8	4.4
28.8	2.7	59.5	3.7
34.4	2.4	61.9	3.1
41.3	2.4	64.3	2.6
49.3	2.7	67.0	2.1
58.9	2.1	69.1	1.8
70.2	2.1	71.2	1.5
83.9	2.1	73.3	1.3
99.9	2.1	75.4	1.1
119	2.1	77.5	0.89
142	1.8	79.3	0.75
169	1.8	81.1	0.63

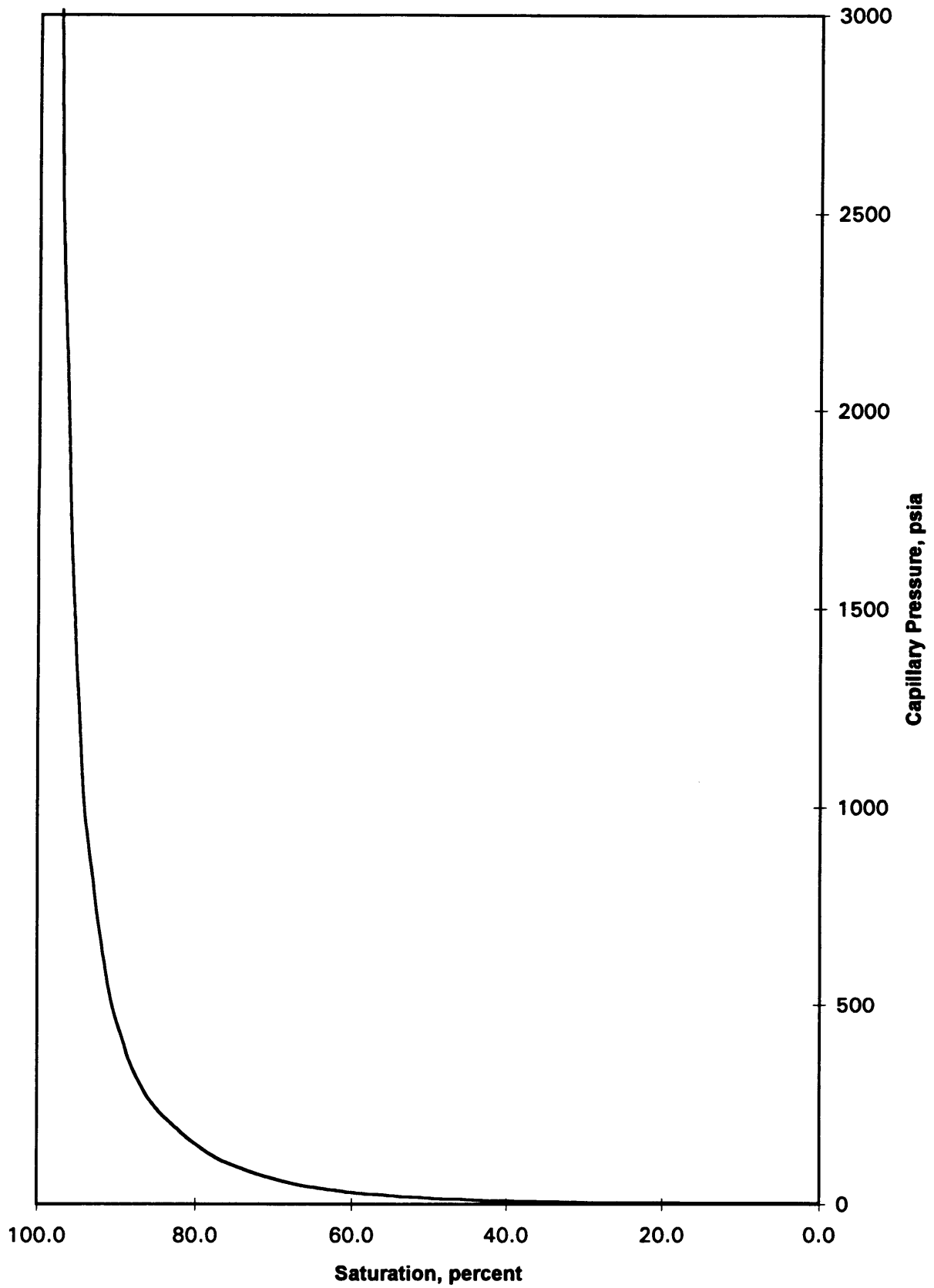
Pressure (psia)	Intrusion percent	Saturation percent	Pore Diameter (μm)
203	1.8	82.9	0.52
244	2.1	85.0	0.43
288	1.6	86.6	0.37
347	1.5	88.1	0.31
413	1.2	89.3	0.26
489	1.2	90.5	0.22
584	0.9	91.4	0.18
697	0.9	92.3	0.15
847	0.9	93.2	0.13
998	0.9	94.1	0.11
1194	0.6	94.7	0.089
1430	0.6	95.3	0.074
1711	0.6	95.9	0.062
2048	0.5	96.4	0.052
2448	0.6	97.0	0.043
2929	0.3	97.3	0.036
3515	0.6	97.9	0.030
4164	0.3	98.2	0.025
5012	0.3	98.5	0.021
5982	0.0	98.5	0.018
7178	0.0	98.5	0.015
8546	0.0	98.5	0.012
10223	0.1	98.6	0.010
12243	0.2	98.8	0.009
14621	0.0	98.8	0.007
17496	0.1	98.9	0.006
20915	0.2	99.1	0.005
24997	0.3	99.4	0.004
29871	0.3	99.7	0.004
35673	0.3	100.0	0.003
39646	0.0	100.0	0.003

Capillary Pressure Vs Saturation

Client: BHP Petroleum

Well: Minerva 2A

Sample: 38

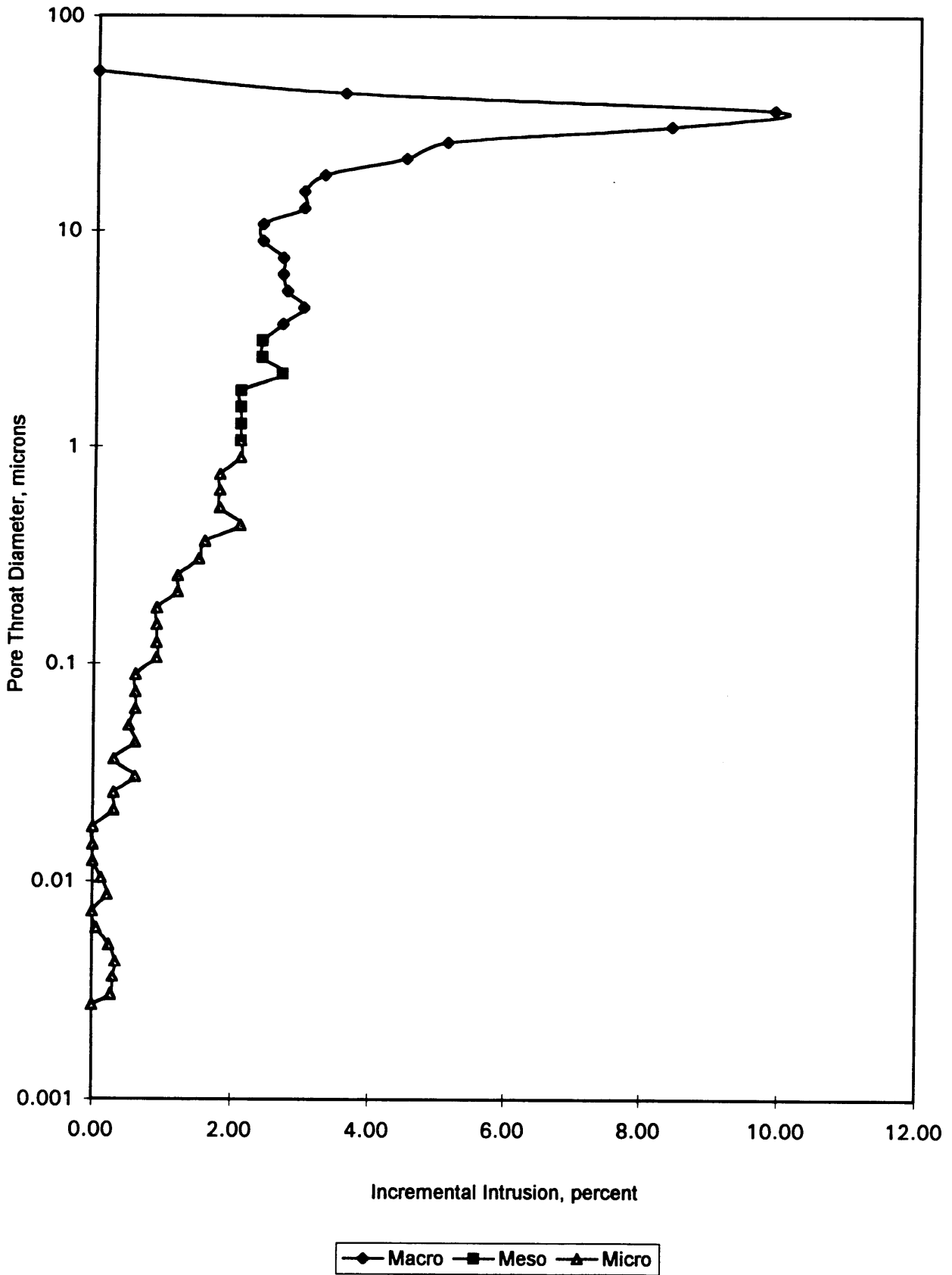


Pore Throat Diameter Vs Incremental Intrusion

Client: BHP Petroleum

Well: Minerva 2A

Sample: 38



CAPILLARY PRESSURE

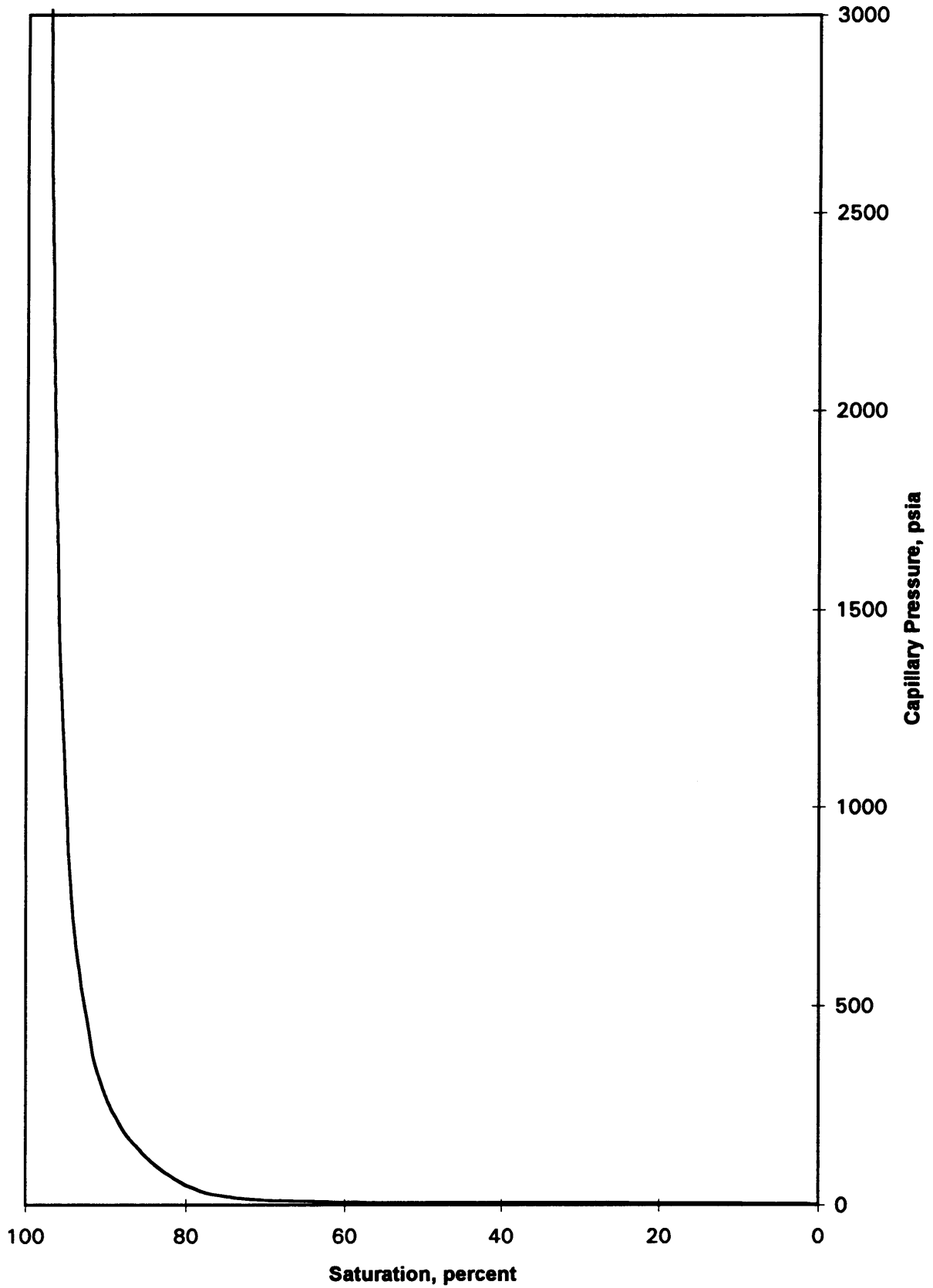
Company	BHP Petroleum Pty Ltd	Phase: 1c
Well	Minerva 2A	
Test Method	Air/Mercury Capillary Pressure	
Sample Number	53	
Depth	1849.50 metres	

Pressure (psia)	Intrusion percent	Saturation percent	Pore Diameter (μm)
2.00	0.0	0.0	53
2.45	1.1	1.1	43
2.89	2.2	3.3	37
3.44	5.8	9.1	31
4.07	4.2	13.3	26
4.81	6.7	20.0	22
5.71	7.5	27.5	19
6.77	6.4	33.9	16
8.02	5.4	39.3	13
9.53	4.6	43.9	11
11.3	3.9	47.9	9.4
13.4	3.0	50.9	7.9
16.0	2.3	53.2	6.6
19.0	1.9	55.1	5.6
21.9	1.6	56.7	4.8
24.9	1.5	58.2	4.2
28.5	1.2	59.5	3.7
32.2	1.2	60.7	3.3
38.5	1.2	61.9	2.7
45.8	1.4	63.3	2.3
54.5	1.6	64.9	1.9
64.5	1.8	66.7	1.6
76.9	1.6	68.3	1.4
91.0	1.6	69.9	1.2

Pressure (psia)	Intrusion percent	Saturation percent	Pore Diameter (μm)
109	1.9	71.8	0.98
128	1.9	73.7	0.83
152	1.9	75.6	0.70
180	1.9	77.5	0.59
215	1.9	79.5	0.49
255	1.8	81.2	0.42
291	1.2	82.4	0.36
362	1.8	84.2	0.29
425	1.2	85.4	0.25
507	1.4	86.8	0.21
600	1.1	87.9	0.18
718	1.2	89.1	0.15
851	1.2	90.3	0.12
1011	1.1	91.4	0.10
1204	0.9	92.4	0.09
1429	0.8	93.2	0.07
1702	0.8	94.0	0.06
2025	0.7	94.7	0.05
2395	0.5	95.2	0.04
2861	0.7	95.9	0.04
3419	0.3	96.2	0.03
4054	0.4	96.6	0.03
4843	0.3	96.9	0.02
5749	0.4	97.3	0.02
6843	0.1	97.4	0.02
8142	0.3	97.7	0.01
9634	0.3	98.0	0.01
11491	0.1	98.1	0.01
13649	0.3	98.4	0.01
16238	0.3	98.6	0.01
19332	0.1	98.8	0.01
23017	0.4	99.2	0.005
27325	0.1	99.3	0.004
32529	0.4	99.7	0.003
38599	0.1	99.9	0.003
39600	0.1	100.0	0.003

Capillary Pressure Vs Saturation

Client: BHP Petroleum
Well: Minerva 2A
Sample: 53

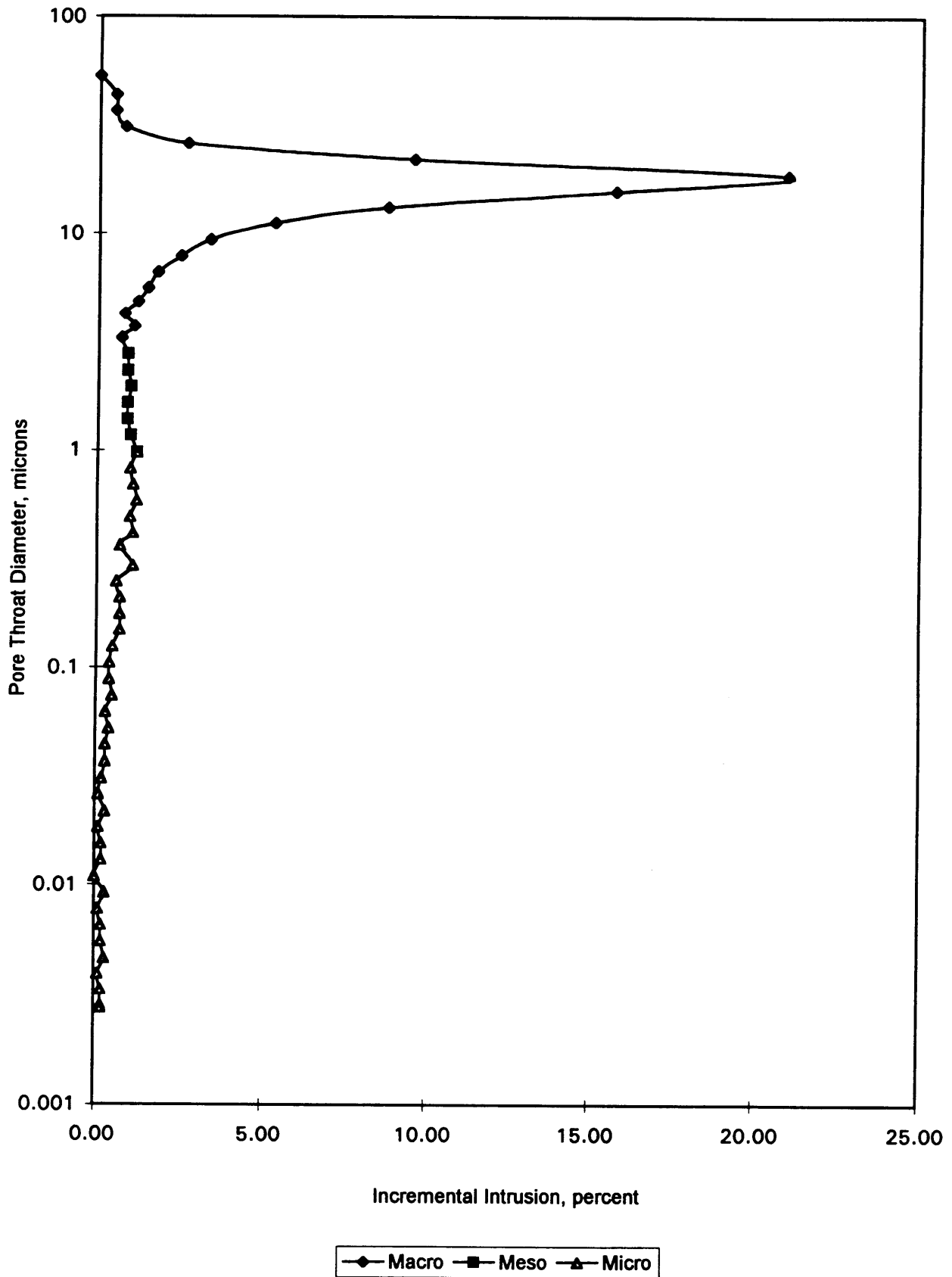


Pore Throat Diameter Vs Incremental Intrusion

Client: BHP Petroleum

Well: Minerva 2A

Sample: 53



CAPILLARY PRESSURE

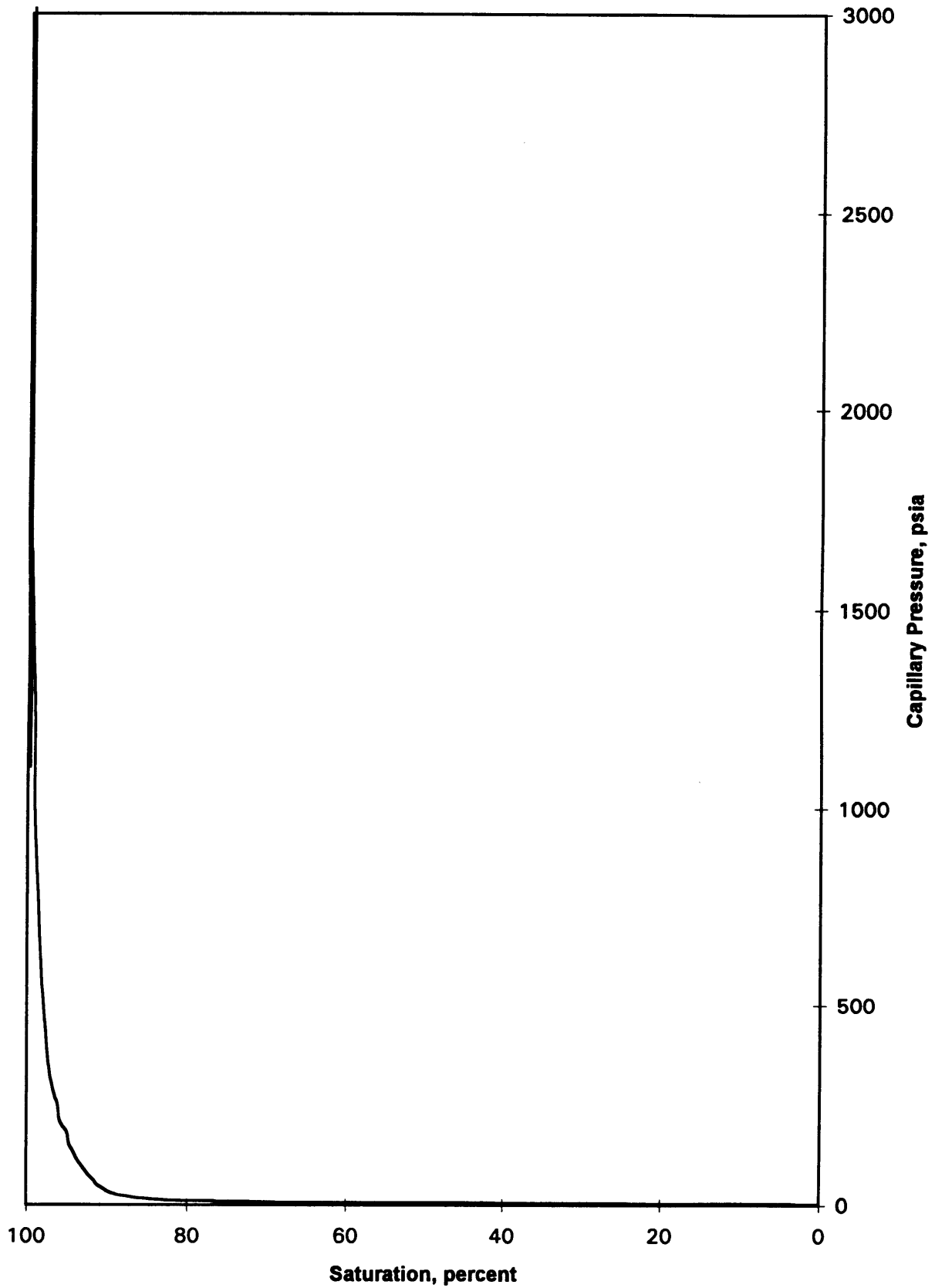
Company	BHP Petroleum Pty Ltd	Phase: 1c
Well	Minerva 2A	
Test Method	Air/Mercury Capillary Pressure	
Sample Number	69	
Depth	1854.30 metres	

Pressure (psia)	Intrusion percent	Saturation percent	Pore Diameter (μm)
2.0	0.0	0.0	53
2.46	0.6	0.6	43
2.88	1.5	2.1	37
3.45	3.2	5.3	31
4.08	8.6	13.9	26
4.80	17.2	31.1	22
5.71	19.8	50.9	19
6.79	14.5	65.4	16
8.04	8.6	74.0	13
9.52	4.7	78.7	11
11.3	3.0	81.7	9.4
13.4	2.1	83.7	7.9
16.0	1.8	85.5	6.6
18.9	1.2	86.7	5.6
21.9	0.9	87.6	4.8
24.9	0.9	88.5	4.2
28.5	0.6	89.1	3.7
32.3	0.6	89.6	3.3
38.3	0.6	90.2	2.8
45.6	0.6	90.8	2.3
54.5	0.6	91.4	1.9
64.6	0.3	91.7	1.6
77.1	0.6	92.3	1.4

Pressure (psia)	Intrusion percent	Saturation percent	Pore Diameter (μm)
91.2	0.6	92.9	1.2
109	0.6	93.5	0.97
128	0.6	94.1	0.82
153	0.6	94.7	0.69
181	0.3	95.0	0.59
214	0.9	95.9	0.49
255	0.3	96.0	0.42
293	0.6	97.0	0.36
358	0.6	97.3	0.30
425	0.3	97.6	0.25
508	0.3	97.9	0.21
604	0.3	98.2	0.17
715	0.3	98.5	0.15
852	0.3	98.8	0.12
1016	0.3	99.1	0.10
1206	0.3	99.1	0.09
1431	0.0	99.1	0.07
1700	0.3	99.7	0.06
2027	0.0	99.7	0.05
2394	0.0	99.7	0.04
2860	0.0	99.7	0.04
3431	0.0	99.7	0.03
4053	0.0	99.7	0.03
4856	0.0	99.7	0.02
5781	0.0	99.7	0.02
6853	0.0	99.7	0.01
8155	0.0	99.7	0.01
9659	0.0	99.7	0.01
1141	0.0	99.7	0.10
13688	0.0	99.7	0.01
16244	0.3	100.0	0.01
19350	0.0	100.0	0.01
23014	0.0	100.0	0.005
27348	0.0	100.0	0.004
32500	0.0	100.0	0.003
38619	0.0	100.0	0.003
39634	0.0	100.0	0.003

Capillary Pressure Vs Saturation

Client: BHP Petroleum
Well: Minerva 2A
Sample: 69

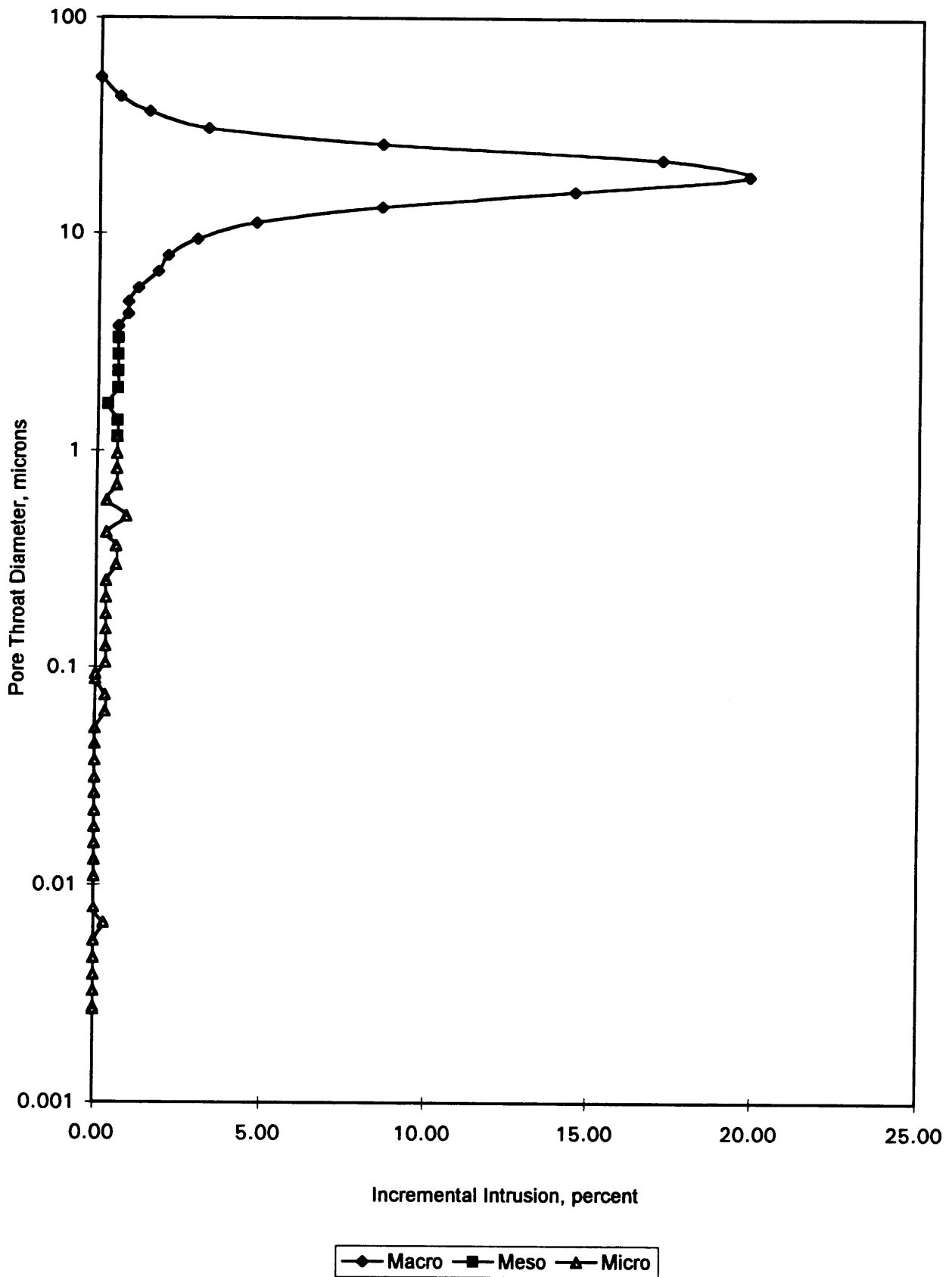


Pore Throat Diameter Vs Incremental Intrusion

Client: BHP Petroleum

Well: Minerva 2A

Sample: 69



CAPILLARY PRESSURE

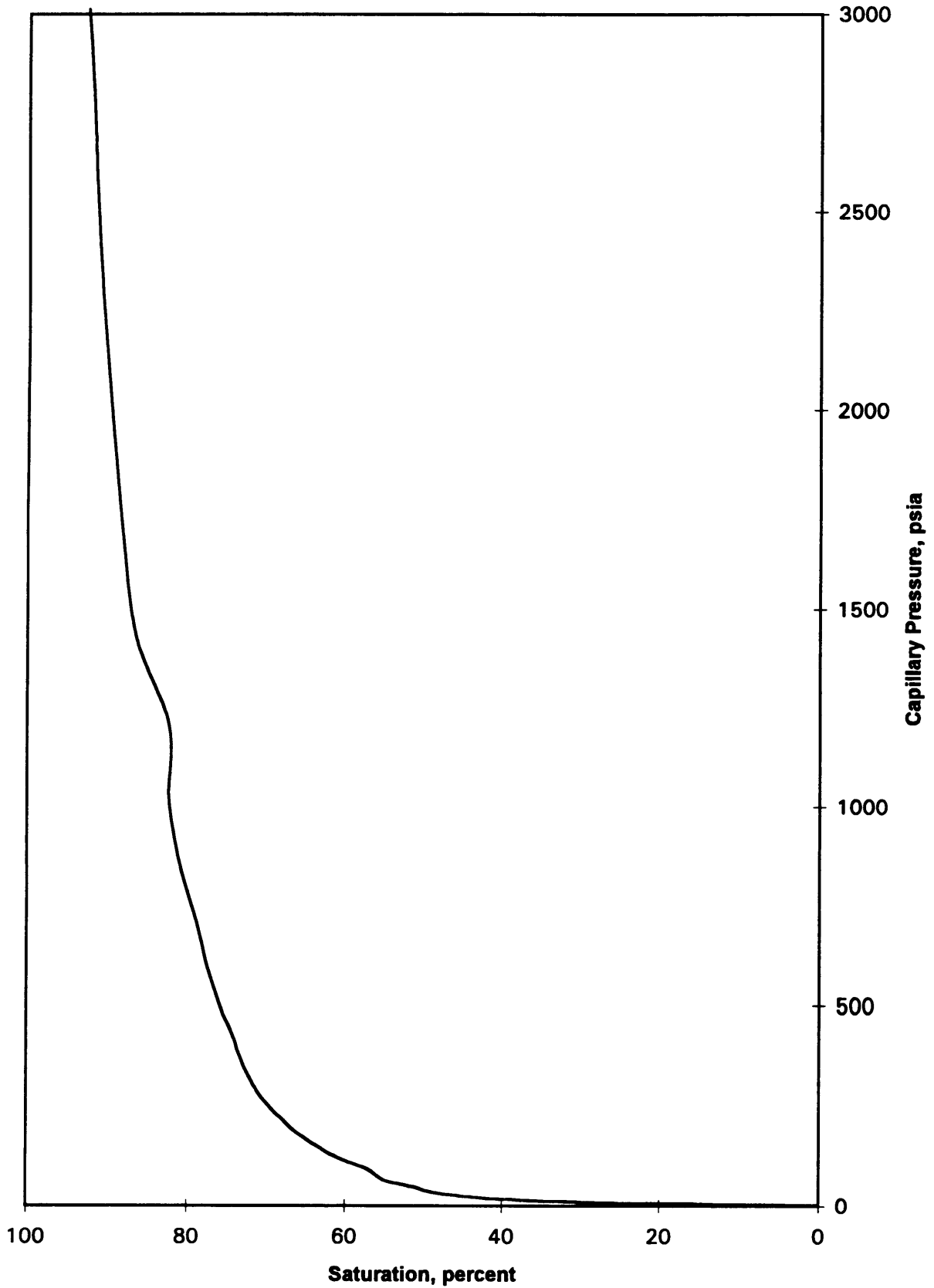
Company	BHP Petroleum Pty Ltd	Phase: 1c
Well	Minerva 2A	
Test Method	Air/Mercury Capillary Pressure	
Sample Number	77	
Depth	1857.30 metres	

Pressure (psia)	Intrusion percent	Saturation percent	Pore Diameter (μm)
2.00	0.0	0.0	53
2.47	1.0	1.0	43
2.89	2.0	2.9	37
3.46	2.9	5.9	31
4.08	3.6	9.6	26
4.81	4.0	13.5	22
5.71	4.4	17.9	19
6.77	4.4	22.4	16
8.02	4.2	26.5	13
9.52	3.7	30.2	11
11.3	3.2	33.4	9.4
13.4	3.2	36.6	7.9
16.0	2.5	39.1	6.6
19.0	2.7	41.8	5.6
21.9	2.0	43.7	4.8
24.9	1.5	45.2	4.2
28.5	1.5	46.7	3.7
32.2	1.5	48.2	3.3
38.2	1.5	49.6	2.8
45.9	1.2	50.9	2.3
54.3	2.0	52.8	2.0
64.8	2.2	55.0	1.6
91.3	2.0	57.0	1.2
109	2.5	59.5	0.97

Pressure (psia)	Intrusion percent	Saturation percent	Pore Diameter (μm)
129	2.2	61.7	0.82
152	2.0	63.6	0.69
181	2.2	65.9	0.58
215	2.0	67.8	0.49
255	2.0	69.8	0.42
292	1.5	71.2	0.36
259	1.7	73.0	0.41
426	1.2	74.0	0.25
505	1.7	76.0	0.21
600	1.5	77.0	0.18
718	1.5	79.0	0.15
851	2.0	81.0	0.12
1014	1.5	82.3	0.10
1204	0.0	82.3	0.09
1429	4.2	86.5	0.07
1701	1.7	88.2	0.06
2022	1.5	90.0	0.05
2398	1.5	91.1	0.04
2861	1.0	92.1	0.04
3427	1.7	93.9	0.03
4049	0.5	94.3	0.03
4866	0.7	95.1	0.02
5720	0.7	96.0	0.02
6845	0.2	96.1	0.01
8147	0.2	96.3	0.01
9660	0.2	96.6	0.01
11489	0.5	97.0	0.01
13658	0.5	97.5	0.01
16247	0.0	97.5	0.01
19251	0.7	98.3	0.01
22986	0.2	98.5	0.005
27370	0.5	99.0	0.004
32488	0.5	99.5	0.003
38567	0.2	99.7	0.003
93533	0.2	100.0	0.003

Capillary Pressure Vs Saturation

Client: BHP Petroleum
Well: Minerva 2A
Sample: 77

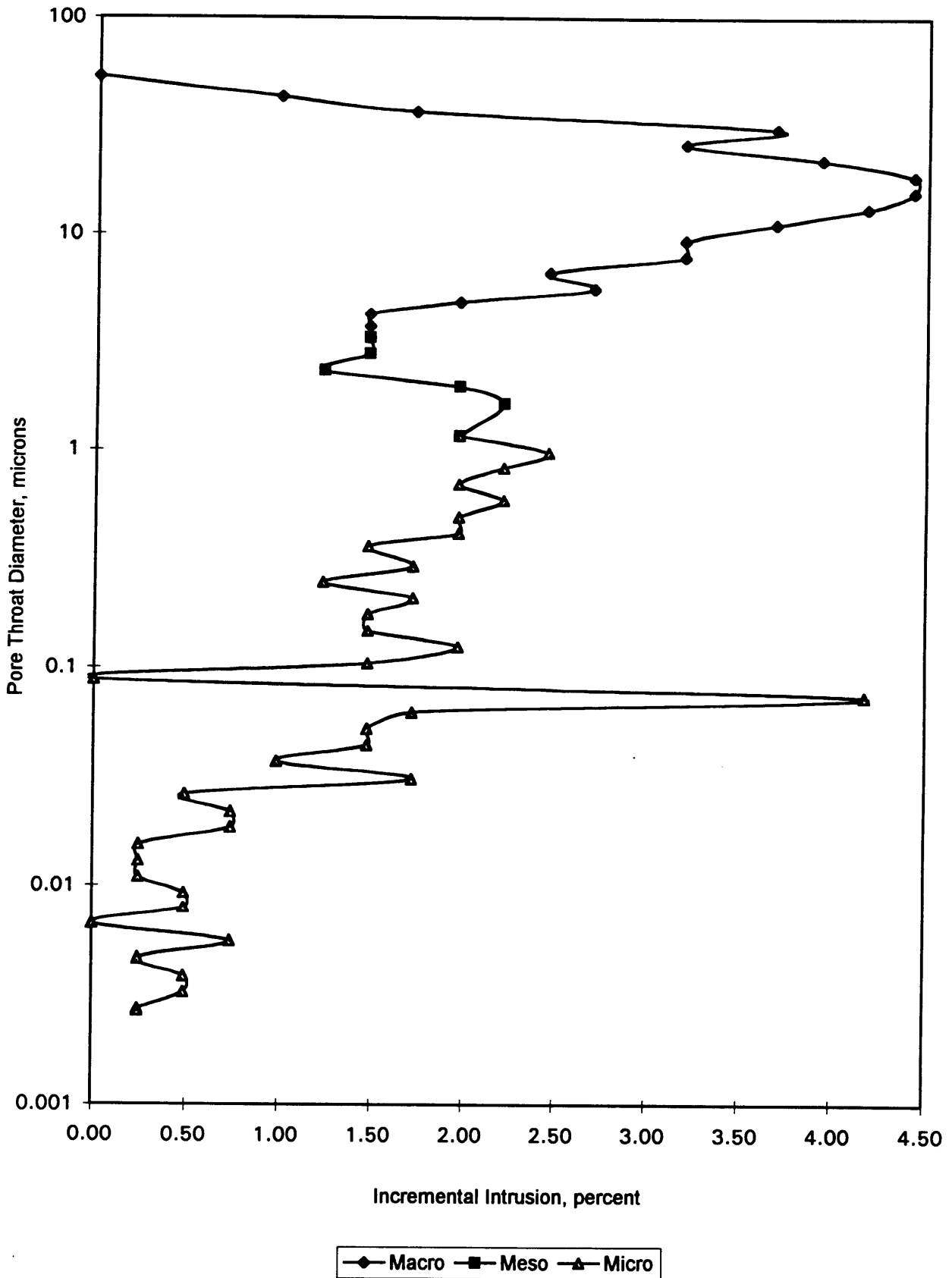


Pore Throat Diameter Vs Incremental Intrusion

Client: BHP Petroleum

Well: Minerva 2A

Sample: 77



CAPILLARY PRESSURE

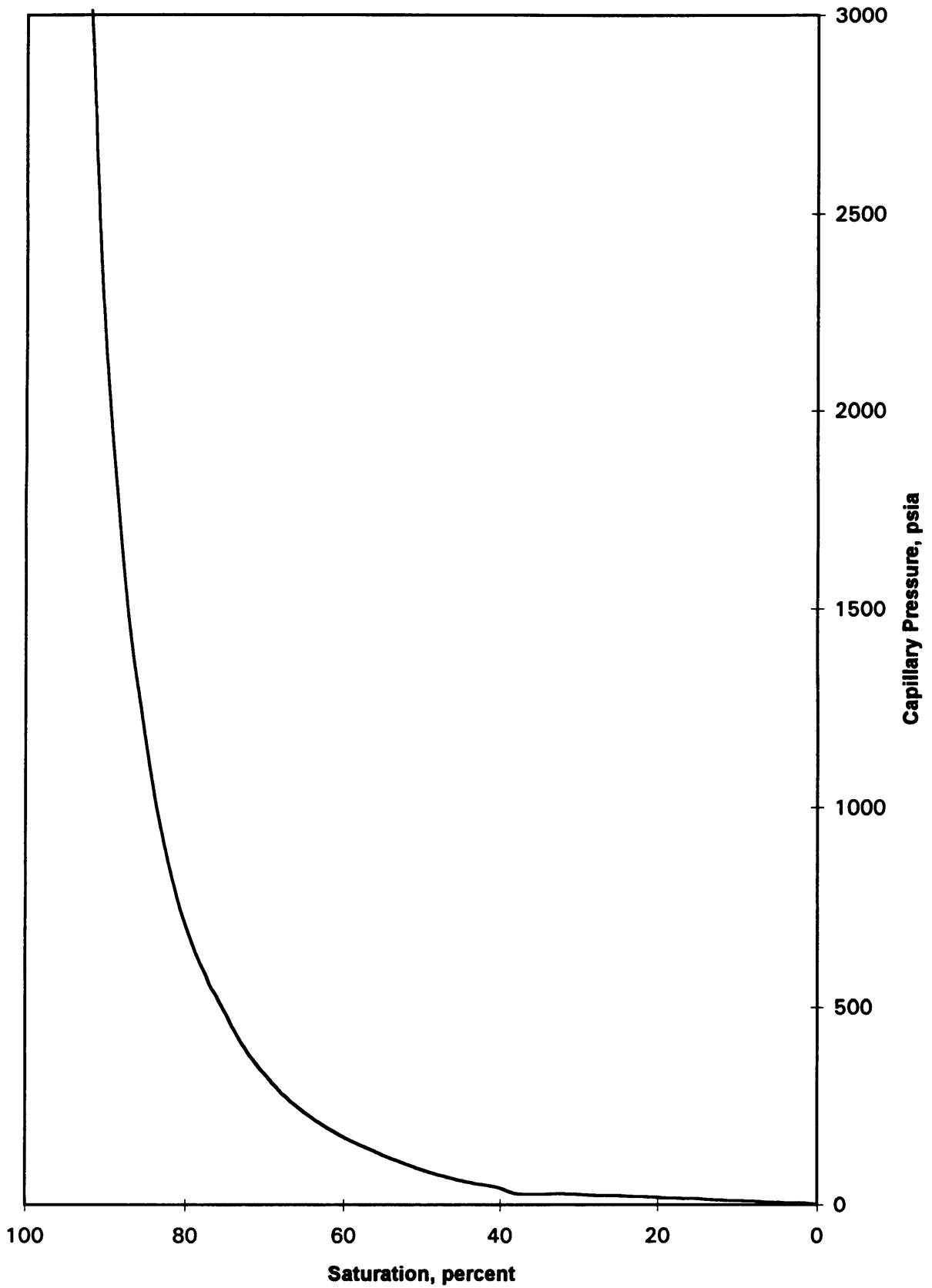
Company	BHP Petroleum Pty Ltd	Phase: 1c
Well	Minerva 2A	
Test Method	Air/Mercury Capillary Pressure	
Sample Number	104	
Depth	1865.40 metres	

Pressure (psia)	Intrusion percent	Saturation percent	Pore Diameter (μm)
2.00	0.0	0.0	53
2.49	0.1	0.1	43
2.88	0.3	0.4	37
3.46	0.3	0.7	31
4.08	0.1	0.9	26
4.81	0.4	1.3	22
5.72	0.4	1.8	19
6.76	0.9	2.7	16
8.02	2.5	5.2	13
9.52	2.8	8.0	11
11.3	2.5	10.5	9.38
13.4	2.5	13.0	7.90
16.0	2.4	15.4	6.64
19.0	4.0	19.4	5.59
21.9	4.1	23.5	4.83
24.9	4.6	28.1	4.25
28.5	4.0	32.1	3.71
38.2	5.6	37.7	3.76
45.6	2.8	40.5	2.32
54.2	2.7	43.2	1.95
64.4	2.4	45.6	1.64
76.7	2.4	47.9	1.38
90.6	2.2	50.1	1.17

Pressure (psia)	Intrusion percent	Saturation percent	Pore Diameter (μm)
108	2.5	52.7	0.98
128	2.4	55.0	0.83
152	2.8	57.8	0.70
180	2.8	60.6	0.59
214	2.8	63.5	0.50
253	2.7	66.1	0.42
292	2.2	68.3	0.36
362	3.0	71.3	0.29
427	2.2	73.5	0.25
506	2.1	75.6	0.21
600	2.5	78.1	0.18
712	2.1	80.2	0.15
846	1.8	81.9	0.12
1010	1.8	83.7	0.10
1199	1.5	85.2	0.09
1426	1.6	86.8	0.07
1696	1.3	88.2	0.06
2016	1.3	89.5	0.05
2391	1.2	90.7	0.04
2854	0.9	91.6	0.04
3412	1.2	92.7	0.03
4029	0.9	93.6	0.03
4846	0.7	94.4	0.02
5735	0.7	95.1	0.02
6827	0.7	95.9	0.01
8112	0.3	96.1	0.01
9652	0.4	96.6	0.01
11445	0.7	97.3	0.01
13640	0.1	97.5	0.01
16234	0.4	97.9	0.01
19359	0.3	98.2	0.005
23004	0.4	98.7	0.005
27314	0.3	99.0	0.004
32518	0.6	99.6	0.003
38557	0.3	99.8	0.003
39594	0.1	100.0	0.003

Capillary Pressure Vs Saturation

Client: BHP Petroleum
Well: Minerva 2A
Sample: 104

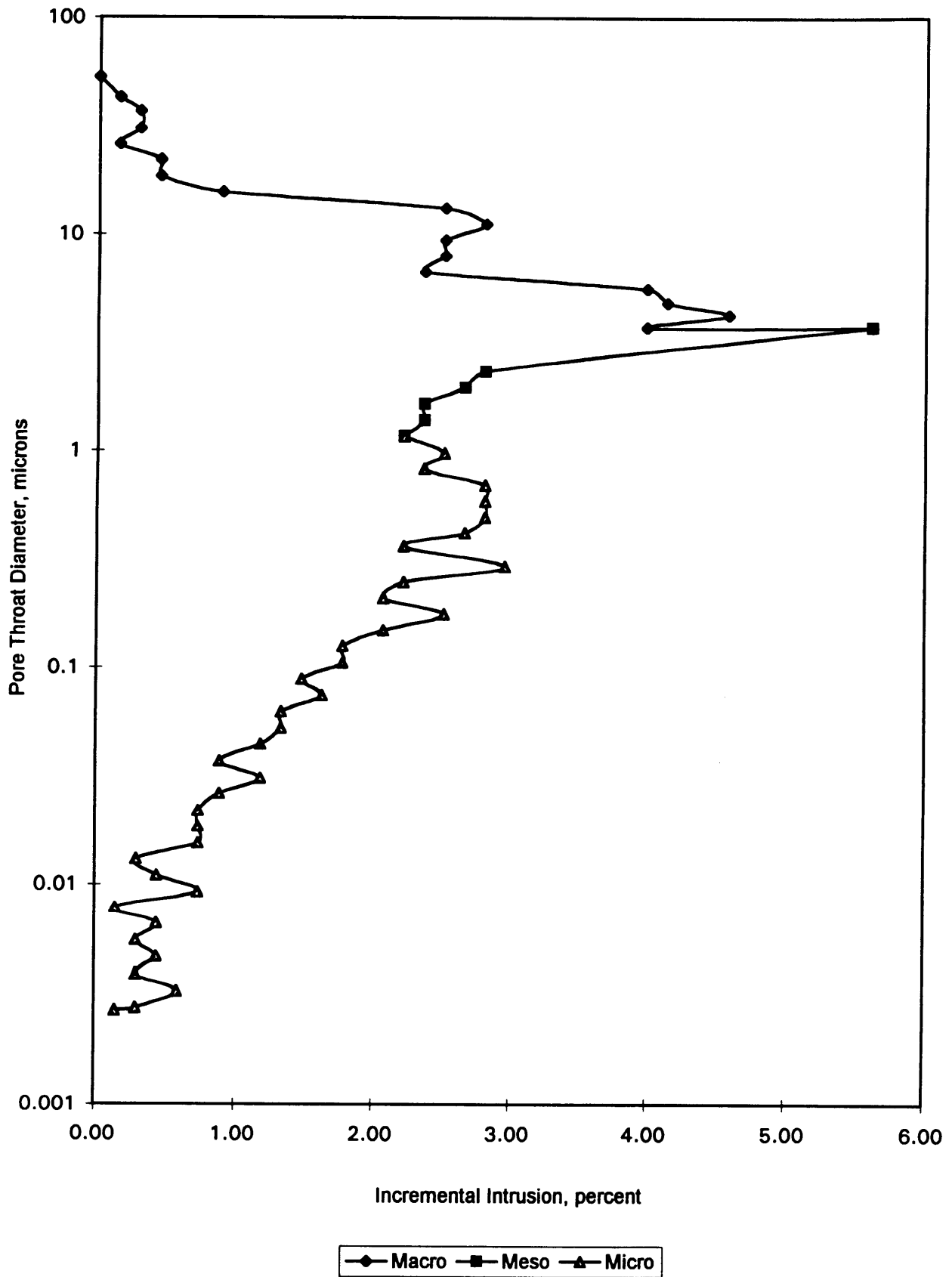


Pore Throat Diameter Vs Incremental Intrusion

Client: BHP Petroleum

Well: Minerva 2A

Sample: 104



CAPILLARY PRESSURE

Company BHP Petroleum Pty Ltd **Phase: 1c**
Well Minerva 2A

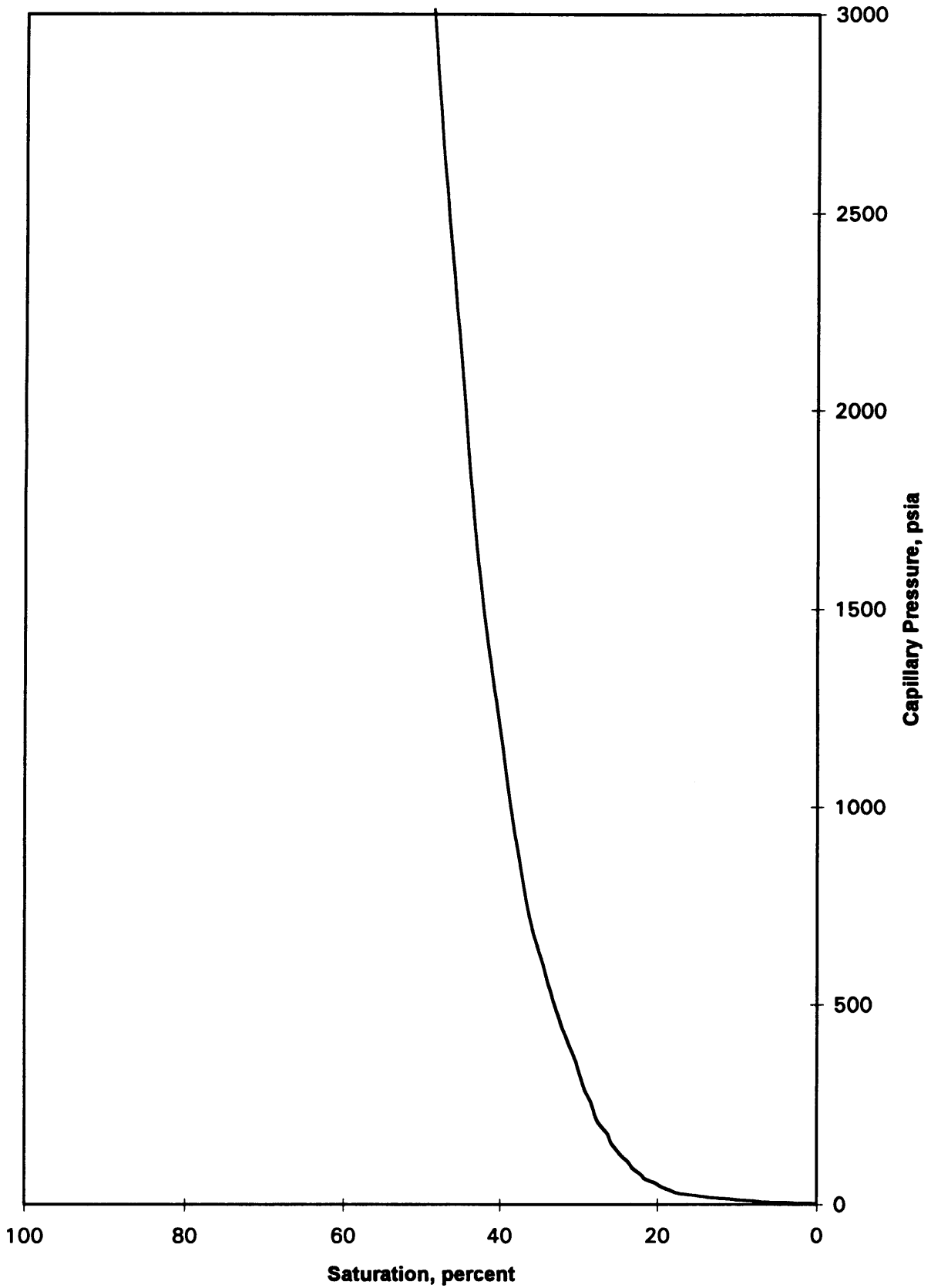
Test Method Air/Mercury Capillary Pressure
Sample Number 108
Depth 1866.60 metres

Pressure (psia)	Intrusion percent	Saturation percent	Pore Diameter (µm)
2.00	0.0	0.0	53
2.48	0.0	0.0	43
2.89	0.3	0.3	37
3.45	0.6	1.0	31
4.08	1.0	1.9	26
4.82	1.0	2.9	22
5.71	1.0	3.9	19
6.77	1.3	5.2	16
8.02	1.3	6.5	13
9.54	1.6	8.1	11
11.33	1.3	9.4	9.36
13.5	1.0	10.4	7.87
16.0	1.6	12.0	6.64
19.0	1.6	13.7	5.59
21.9	1.3	15.0	4.83
24.9	1.0	16.0	4.25
28.5	1.3	17.3	3.72
32.0	0.6	17.9	3.31
38.3	0.6	18.6	2.77
45.8	1.0	19.5	2.31
54.2	0.6	20.2	1.95
64.5	1.3	21.5	1.64
76.8	0.6	22.1	1.38
90.9	1.0	23.1	1.17
108.2	0.6	23.8	0.98

Pressure (psia)	Intrusion percent	Saturation percent	Pore Diameter (μm)
128	1.0	24.7	0.83
151	1.0	25.7	0.70
180	0.6	26.4	0.59
213	1.3	27.7	0.50
255	0.6	28.3	0.42
294	1.0	29.3	0.36
360	1.0	30.3	0.29
423	1.3	31.6	0.25
507	1.6	33.2	0.21
600	1.3	34.5	0.18
712	1.6	36.2	0.15
851	1.3	37.5	0.12
1011	1.3	38.8	0.10
1203	1.3	40.1	0.09
1426	1.6	41.7	0.07
1703	1.6	43.3	0.06
2027	1.3	44.6	0.05
2394	1.6	46.2	0.04
2862	1.9	48.2	0.04
3422	1.6	49.8	0.03
4066	1.6	51.5	0.03
4836	2.3	53.7	0.02
5730	2.3	56.0	0.02
6858	2.9	59.0	0.01
8107	2.9	61.9	0.01
9654	3.9	65.8	0.01
11490	4.6	70.4	0.01
13619	5.5	75.9	0.01
16241	4.9	80.8	0.01
19319	4.9	85.7	0.005
23002	3.9	89.6	0.005
27326	3.3	92.8	0.004
32502	3.3	96.1	0.003
38661	2.9	99.0	0.003
39698	1.0	100.0	0.003

Capillary Pressure Vs Saturation

Client: BHP Petroleum
Well: Minerva 2A
Sample: 108

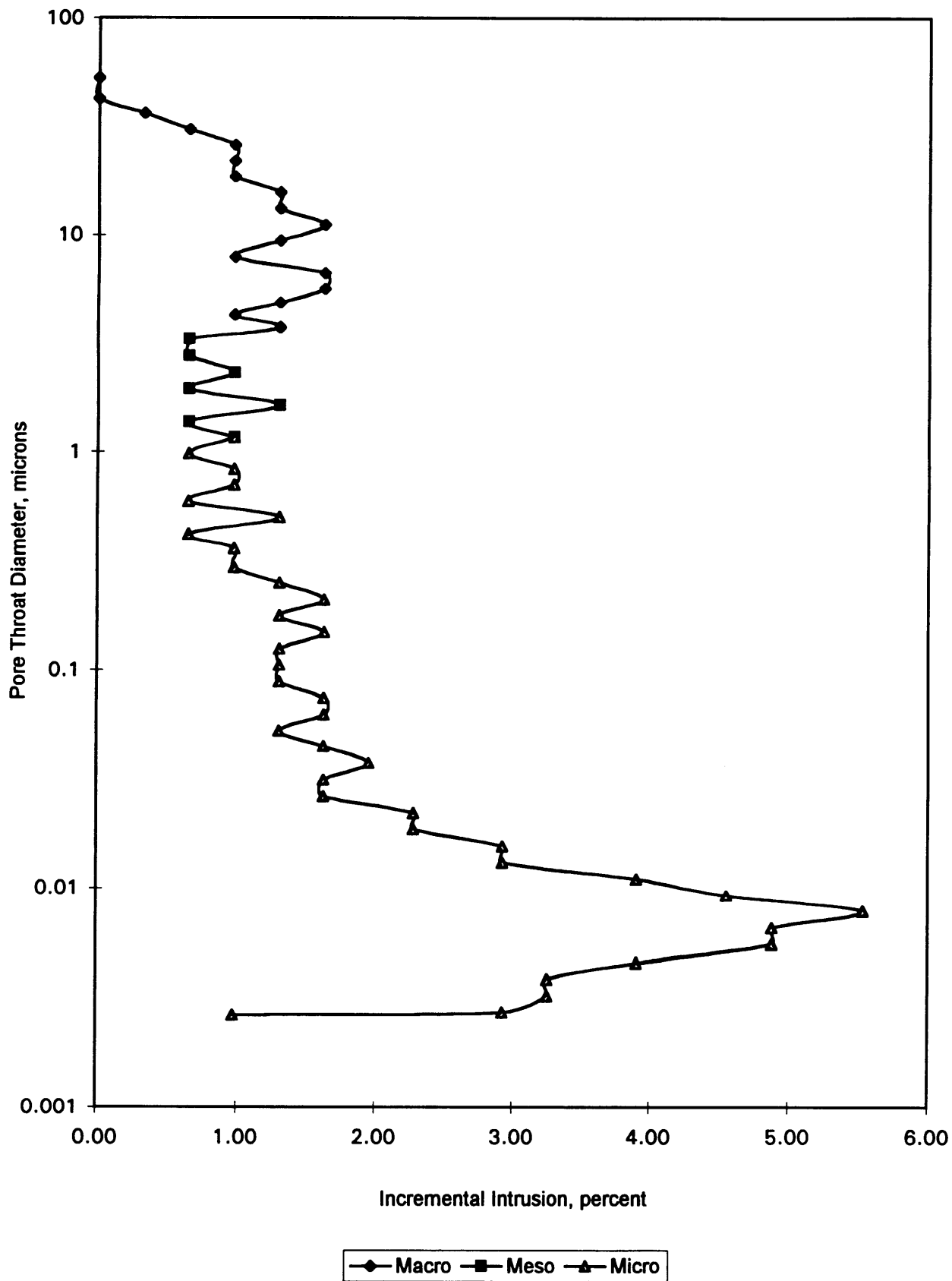


Pore Throat Diameter Vs Incremental Intrusion

Client: BHP Petroleum

Well: Minerva 2A

Sample: 108



CAPILLARY PRESSURE

Company BHP Petroleum Pty Ltd **Phase: 1c**
Well Minerva 2A

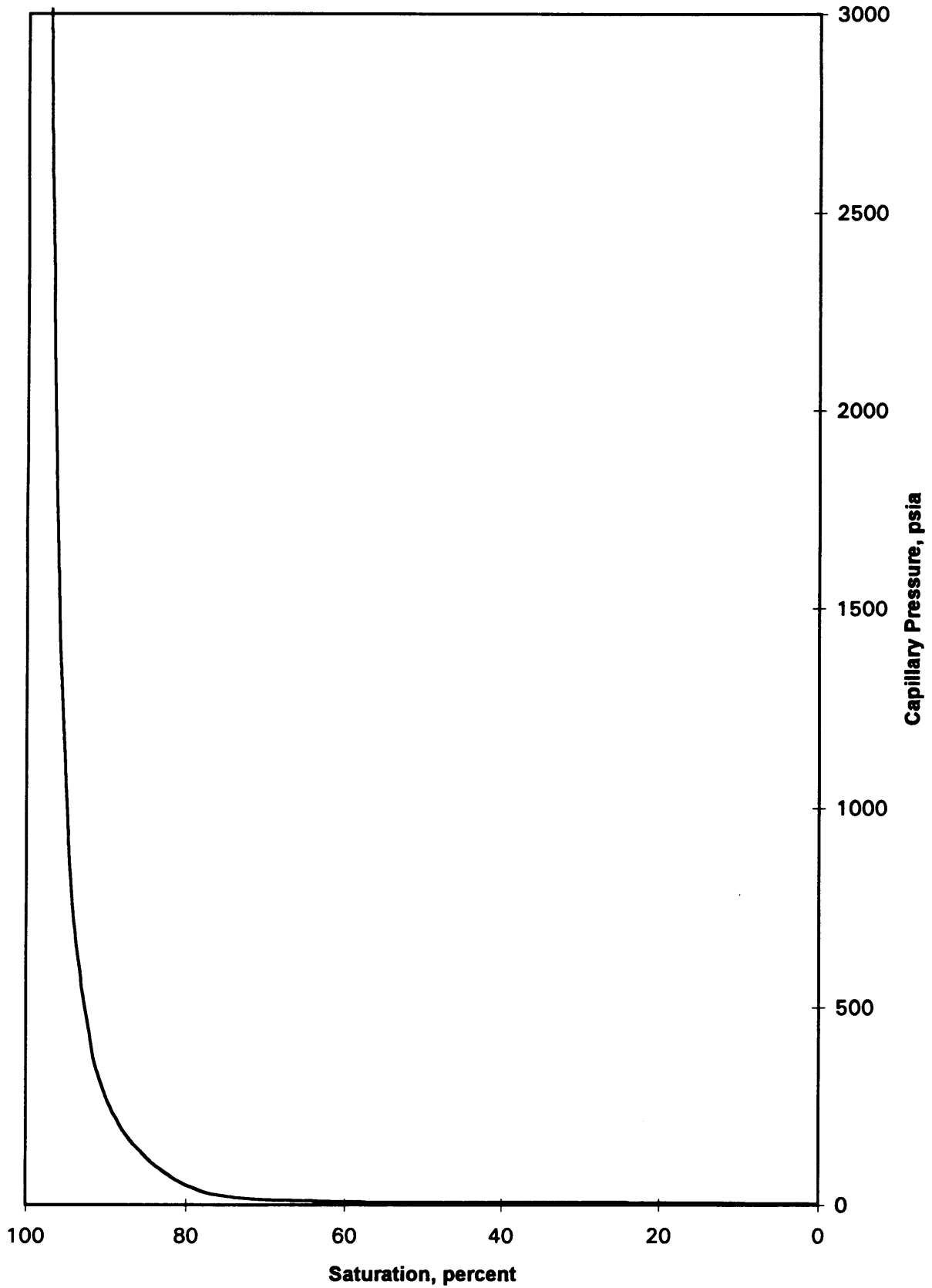
Test Method Air/Mercury Capillary Pressure
Sample Number 117
Depth 1869.30 metres

Pressure (psia)	Intrusion percent	Saturation percent	Pore Diameter (μm)
2.00	0.0	0.0	53
2.45	0.5	0.5	43
2.89	0.5	1.0	37
3.44	0.8	1.8	31
4.09	2.7	4.4	26
4.84	9.6	14.0	22
5.70	20.9	35.0	19
6.77	15.8	50.7	16
8.02	8.8	59.5	13
9.53	5.3	64.8	11
11.3	3.3	68.2	9.36
13.4	2.5	70.6	7.89
16.0	1.8	72.4	6.63
19.0	1.5	73.9	5.59
21.9	1.2	75.1	4.83
24.9	0.8	75.9	4.25
28.5	1.1	76.9	3.72
32.3	0.7	77.6	3.28
38.3	0.9	78.5	2.77
45.8	0.9	79.4	2.32
54.1	1.0	80.4	1.96
64.6	0.9	81.3	1.64
76.6	0.9	82.2	1.38

Pressure (psia)	Intrusion percent	Saturation percent	Pore Diameter (μm)
90.7	1.0	83.1	1.17
108	1.2	84.3	0.98
128	1.0	85.3	0.83
152	1.1	86.4	0.70
180	1.2	87.6	0.59
214	1.0	88.6	0.50
254	1.1	89.6	0.42
291	0.7	90.3	0.36
359	1.1	91.4	0.29
425	0.6	92.0	0.25
505	0.7	92.7	0.21
600	0.7	93.4	0.18
711	0.7	94.1	0.15
848	0.5	94.6	0.12
1011	0.4	95.0	0.10
1203	0.4	95.4	0.09
1430	0.5	95.9	0.07
1700	0.3	96.2	0.06
2019	0.4	96.5	0.05
2397	0.3	96.8	0.04
2859	0.3	97.1	0.04
3419	0.2	97.3	0.03
4052	0.1	97.4	0.03
4862	0.3	97.7	0.02
5763	0.1	97.8	0.02
6858	0.2	98.0	0.01
8131	0.2	98.2	0.01
9656	0.0	98.2	0.01
11494	0.3	98.5	0.01
13680	0.1	98.6	0.01
16245	0.2	98.8	0.01
19314	0.2	99.0	0.005
23001	0.3	99.3	0.005
27340	0.1	99.4	0.004
32506	0.2	99.6	0.003
38604	0.2	99.8	0.003
39548	0.2	100.0	0.003

Capillary Pressure Vs Saturation

Client: BHP Petroleum
Well: Minerva 2A
Sample: 117

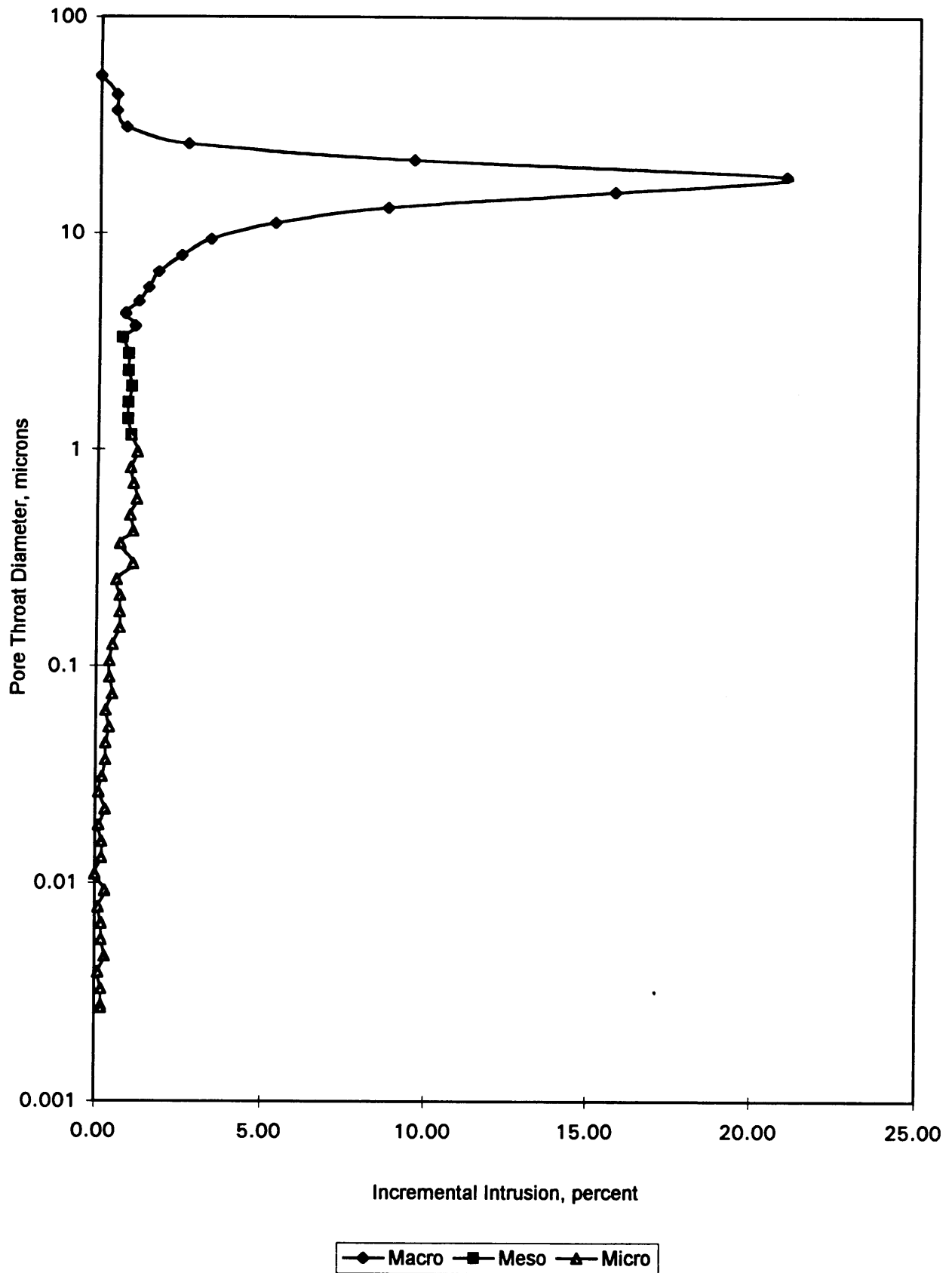


Pore Throat Diameter Vs Incremental Intrusion

Client: BHP Petroleum

Well: Minerva 2A

Sample: 117



CAPILLARY PRESSURE

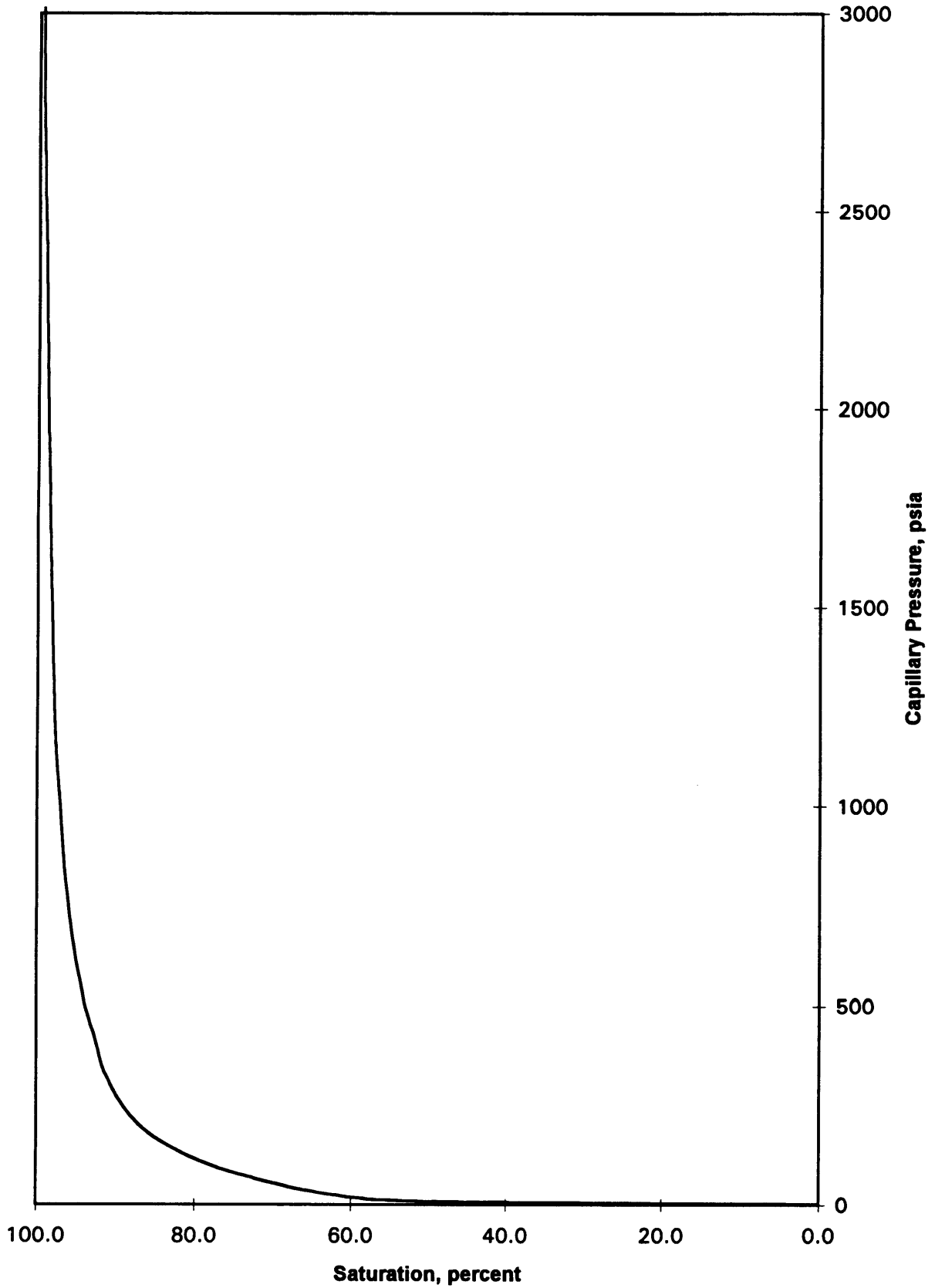
Company	BHP Petroleum Pty Ltd	Phase: 1c
Well	Minerva 2A	
Test Method	Air/Mercury Capillary Pressure	
Sample Number	158	
Depth	1881.60 metres	

Pressure (psia)	Intrusion percent	Saturation percent	Pore Diameter (μm)
1.93	0.0	0.0	55
2.45	0.5	0.5	43
2.92	2.3	2.8	36
3.46	3.5	6.3	31
4.13	6.4	12.7	26
4.91	12.0	24.7	22
5.85	11.0	35.7	18
6.98	7.7	43.3	15
8.33	5.2	48.5	13
9.94	3.7	52.2	11
11.9	2.8	55.0	8.9
14.2	2.1	57.0	7.5
16.9	1.9	59.0	6.3
20.2	1.6	60.5	5.2
24.1	1.6	62.1	4.4
28.8	1.6	63.7	3.7
34.4	1.6	65.2	3.1
41.3	1.9	67.1	2.6
49.3	1.7	68.9	2.1
58.9	2.3	71.1	1.8
70.2	2.1	73.2	1.5
83.9	2.4	75.7	1.3
99.9	2.4	78.1	1.1
119	2.4	80.5	0.89

Pressure (psia)	Intrusion percent	Saturation percent	Pore Diameter (μm)
142	2.3	82.8	0.75
169	2.3	85.0	0.63
203	2.1	87.1	0.52
244	1.7	88.9	0.43
288	1.4	90.3	0.37
347	1.4	91.7	0.31
413	0.9	92.5	0.26
489	1.2	93.7	0.22
584	1.0	94.8	0.18
697	0.9	95.7	0.15
847	0.9	96.5	0.13
998	0.5	97.0	0.11
1194	0.7	97.7	0.089
1430	0.3	98.1	0.074
1711	0.3	98.4	0.062
2048	0.3	98.8	0.052
2448	0.3	99.1	0.043
2929	0.3	99.5	0.036
3515	0.2	99.7	0.030
4164	0.2	99.8	0.025
5012	0.0	99.8	0.021
5982	0.0	99.8	0.018
7178	0.2	100.0	0.015
8546	0.0	100.0	0.012
10223	0.0	100.0	0.010
12243	0.0	100.0	0.009
14621	0.0	100.0	0.007
17496	0.0	100.0	0.006
20915	0.0	100.0	0.005
24997	0.0	100.0	0.004
29871	0.0	100.0	0.004
35673	0.0	100.0	0.003
39646	0.0	100.0	0.003

Capillary Pressure Vs Saturation

Client: BHP Petroleum
Well: Minerva 2A
Sample: 158

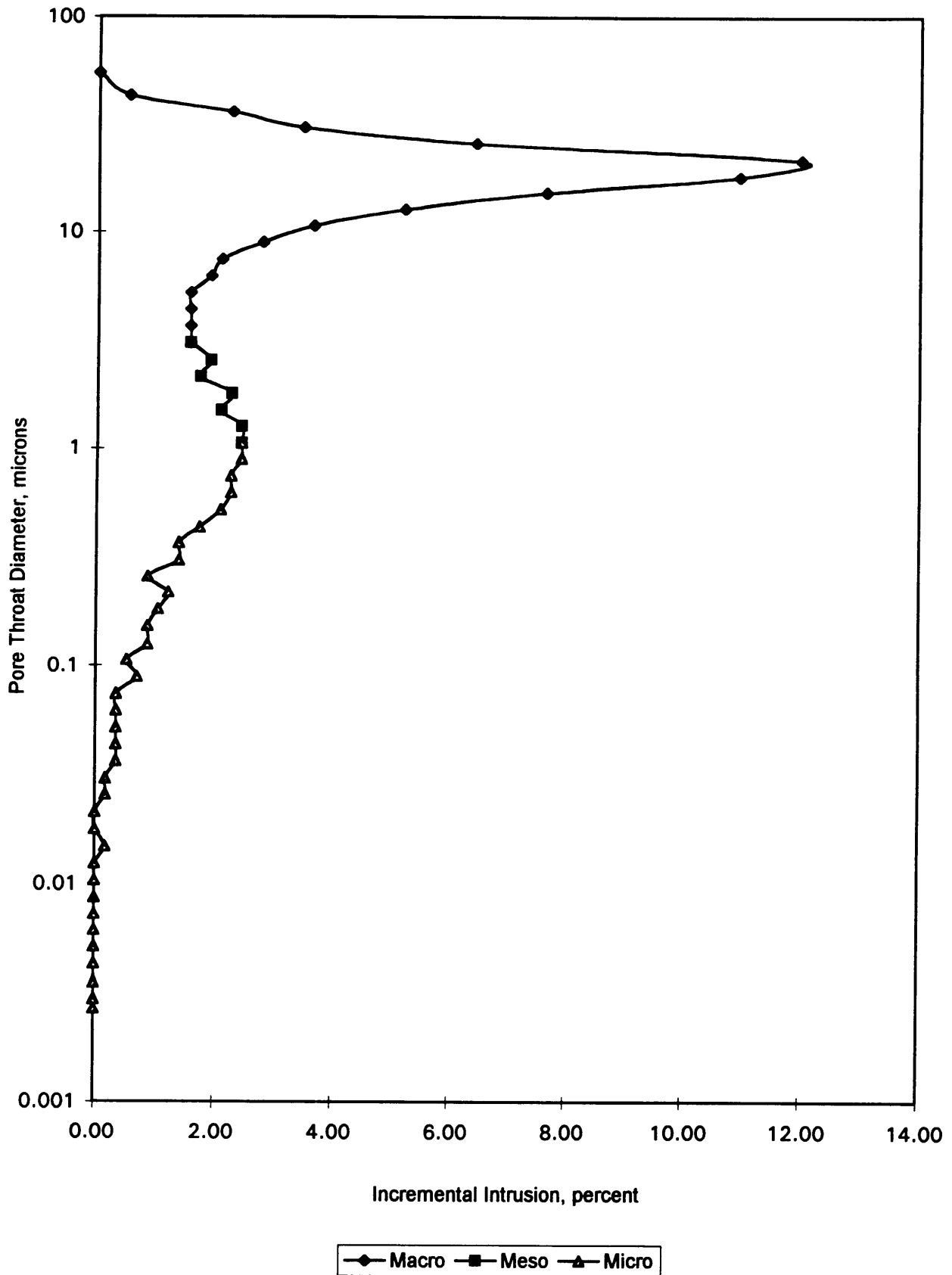


Pore Throat Diameter Vs Incremental Intrusion

Client: BHP Petroleum

Well: Minerva 2A

Sample: 158



CAPILLARY PRESSURE

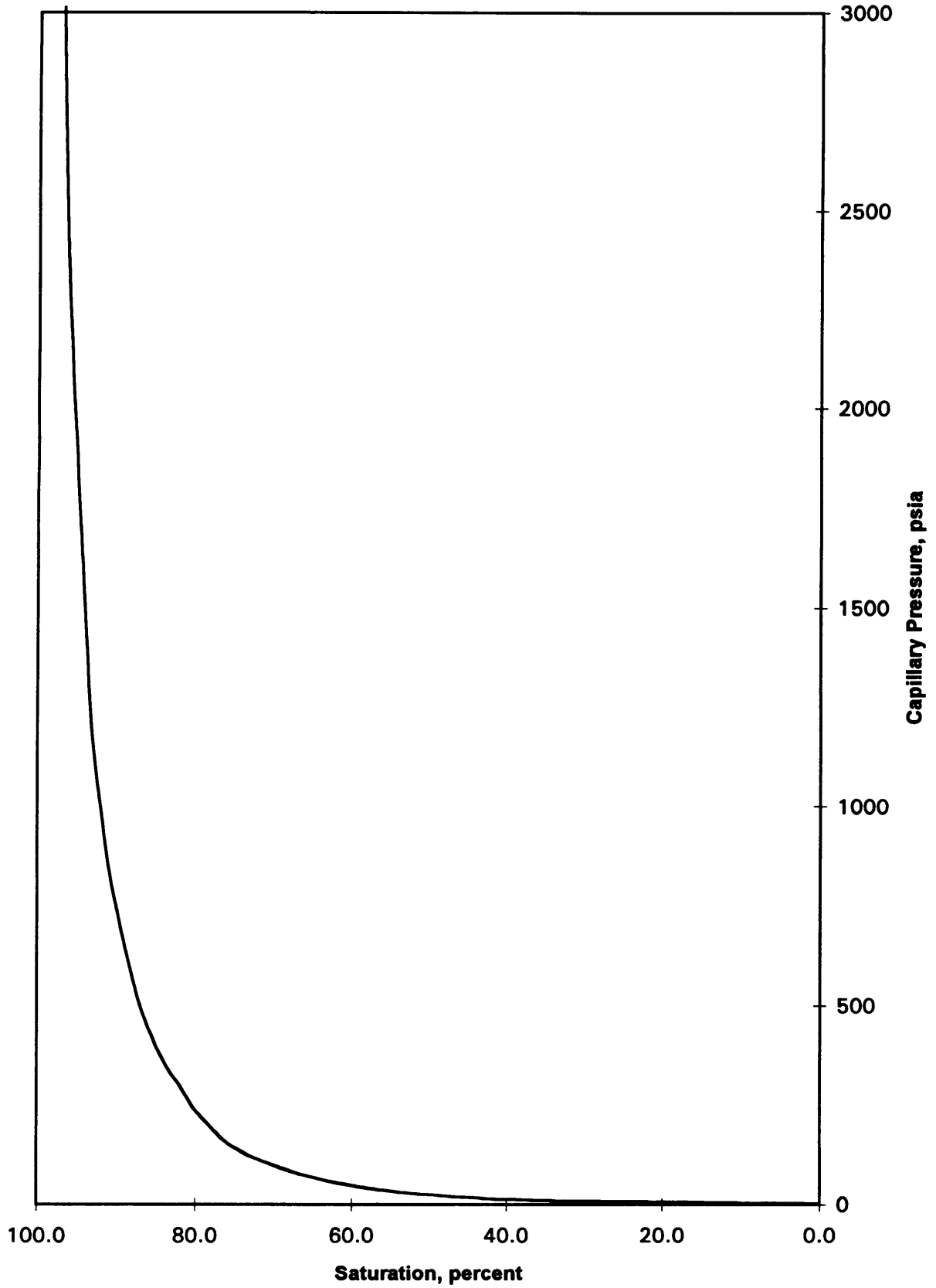
Company	BHP Petroleum Pty Ltd	Phase: 1c
Well	Minerva 2A	
Test Method	Air/Mercury Capillary Pressure	
Sample Number	161	
Depth	1882.50 metres	

Pressure (psia)	Intrusion percent	Saturation percent	Pore Diameter (μm)
1.93	0.0	0.0	55
2.47	0.5	0.5	43
2.92	0.8	1.3	36
3.47	2.4	3.7	31
4.13	3.6	7.3	26
4.91	4.4	11.7	22
5.86	7.0	18.7	18
6.98	6.5	25.2	15
8.34	5.6	30.8	13
9.94	4.2	35.0	11
11.9	3.4	38.4	8.9
14.2	3.0	41.4	7.5
16.9	2.9	44.3	6.3
20.2	2.8	47.1	5.2
24.2	2.7	49.8	4.4
28.9	2.7	52.5	3.7
34.5	2.7	55.2	3.1
41.3	2.7	57.9	2.6
49.2	2.7	60.6	2.2
58.7	2.5	63.1	1.8
70.3	2.5	65.6	1.5
83.7	2.3	67.8	1.3
99.6	2.5	70.3	1.1
119	2.3	72.6	0.89

Pressure (psia)	Intrusion percent	Saturation percent	Pore Diameter (μm)
142	2.4	75.0	0.75
169	1.8	76.8	0.63
203	1.5	78.3	0.52
240	1.8	80.1	0.44
288	1.5	81.7	0.37
344	1.9	83.6	0.31
409	1.7	85.2	0.26
495	1.7	86.9	0.21
593	1.4	88.3	0.18
701	1.3	89.5	0.15
836	1.4	90.9	0.13
1009	1.2	92.1	0.11
1196	1.1	93.2	0.089
1431	0.7	93.9	0.074
1711	0.7	94.6	0.062
2047	1.0	95.6	0.052
2448	0.8	96.4	0.043
2927	0.5	96.9	0.036
3515	0.5	97.4	0.030
4178	0.2	97.7	0.025
5024	0.3	98.0	0.021
6005	0.4	98.4	0.018
7155	0.2	98.6	0.015
8573	0.2	98.8	0.012
10235	0.1	98.9	0.010
12229	0.1	99.1	0.009
14620	0.2	99.3	0.007
17485	0.3	99.6	0.006
20924	0.1	99.6	0.005
25012	0.1	99.8	0.004
29870	0.0	99.8	0.004
35698	0.2	100.0	0.003
39634	0.0	100.0	0.003

Capillary Pressure Vs Saturation

Client: BHP Petroleum
Well: Minerva 2A
Sample: 161

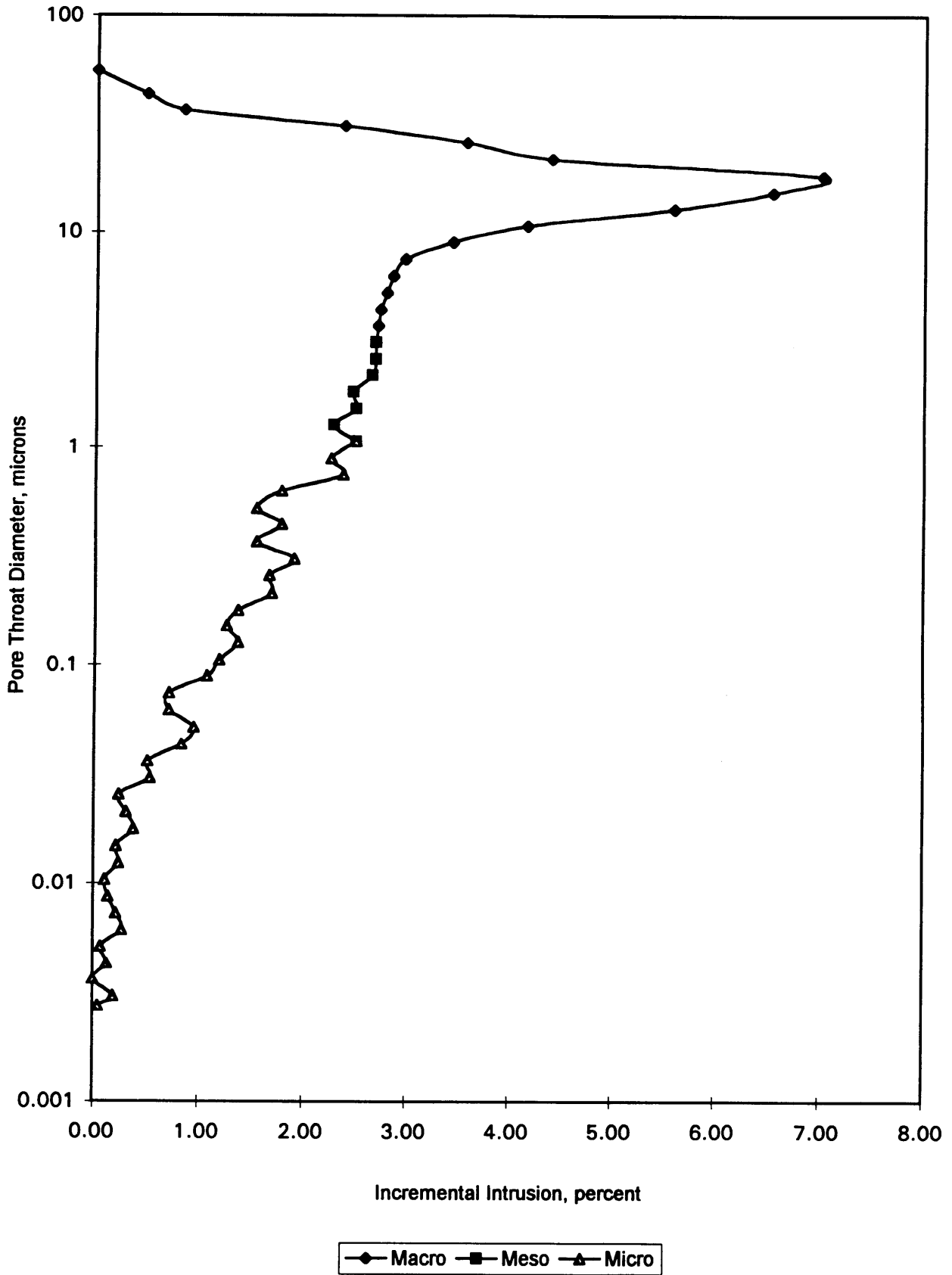


Pore Throat Diameter Vs Incremental Intrusion

Client: BHP Petroleum

Well: Minerva 2A

Sample: 161



CAPILLARY PRESSURE

Company BHP Petroleum Pty Ltd **Phase: 1c**
Well Minerva 2A

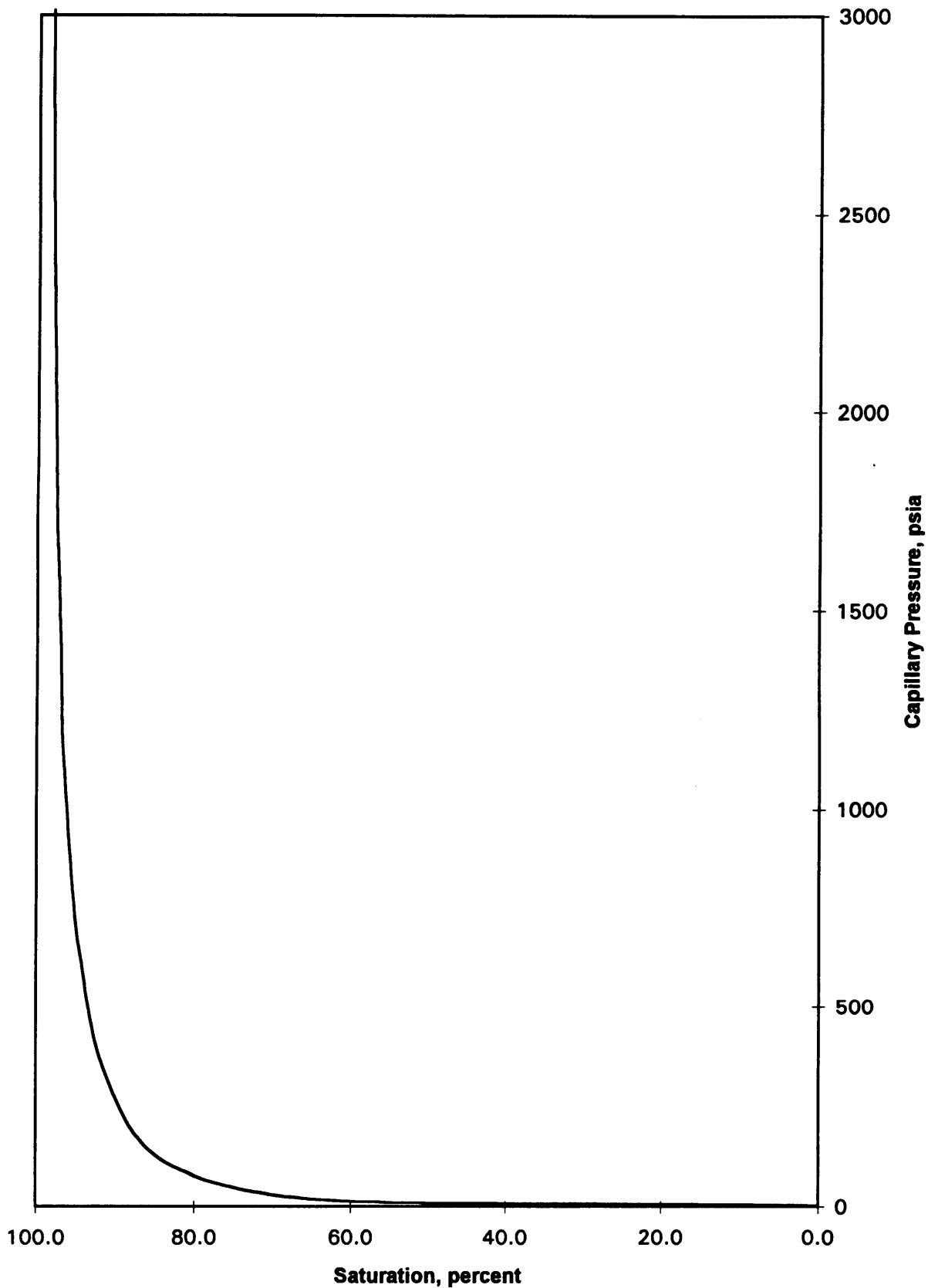
Test Method Air/Mercury Capillary Pressure
Sample Number 163
Depth 1915.30 metres

Pressure (psia)	Intrusion percent	Saturation percent	Pore Diameter (μm)
2.08	0.0	0.0	51
2.47	0.4	0.4	43
2.92	0.7	1.2	36
3.47	1.2	2.4	31
4.15	2.8	5.2	26
4.91	5.6	10.8	22
5.86	10.3	21.1	18
6.98	14.0	35.2	15
8.33	10.8	45.9	13
9.94	6.9	52.9	11
11.9	4.4	57.3	8.9
14.2	3.1	60.4	7.5
16.9	2.5	62.9	6.3
20.2	2.4	65.3	5.2
24.1	2.2	67.5	4.4
28.8	1.9	69.4	3.7
34.2	1.9	71.3	3.1
41.2	2.1	73.4	2.6
49.3	1.8	75.2	2.2
58.4	1.8	77.0	1.8
70.2	2.1	79.0	1.5
83.7	1.6	80.6	1.3
100	1.9	82.6	1.1
119	1.6	84.2	0.89

Pressure (psia)	Intrusion percent	Saturation percent	Pore Diameter (μm)
142	1.5	85.7	0.75
168	1.2	86.9	0.63
203	1.3	88.2	0.52
240	1.0	89.2	0.44
287	1.0	90.3	0.37
345	1.2	91.4	0.31
410	1.0	92.5	0.26
490	0.9	93.4	0.22
586	0.7	94.1	0.18
699	0.9	95.0	0.15
836	0.6	95.6	0.13
1003	0.6	96.2	0.11
1197	0.6	96.8	0.089
1428	0.3	97.0	0.074
1712	0.4	97.5	0.062
2045	0.3	97.8	0.052
2450	0.3	98.1	0.043
2927	0.1	98.2	0.036
3521	0.1	98.4	0.030
4178	0.1	98.5	0.025
5027	0.1	98.7	0.021
5990	0.0	98.7	0.018
7157	0.1	98.8	0.015
8563	0.0	98.8	0.012
10236	0.0	98.8	0.010
12231	0.0	98.8	0.009
14624	0.1	99.0	0.007
17486	0.1	99.1	0.006
20916	0.1	99.3	0.005
25012	0.1	99.4	0.004
29896	0.1	99.6	0.004
35747	0.1	99.7	0.003
39772	0.3	100.0	0.003

Capillary Pressure Vs Saturation

Client: BHP Petroleum
Well: Minerva 2A
Sample: 163

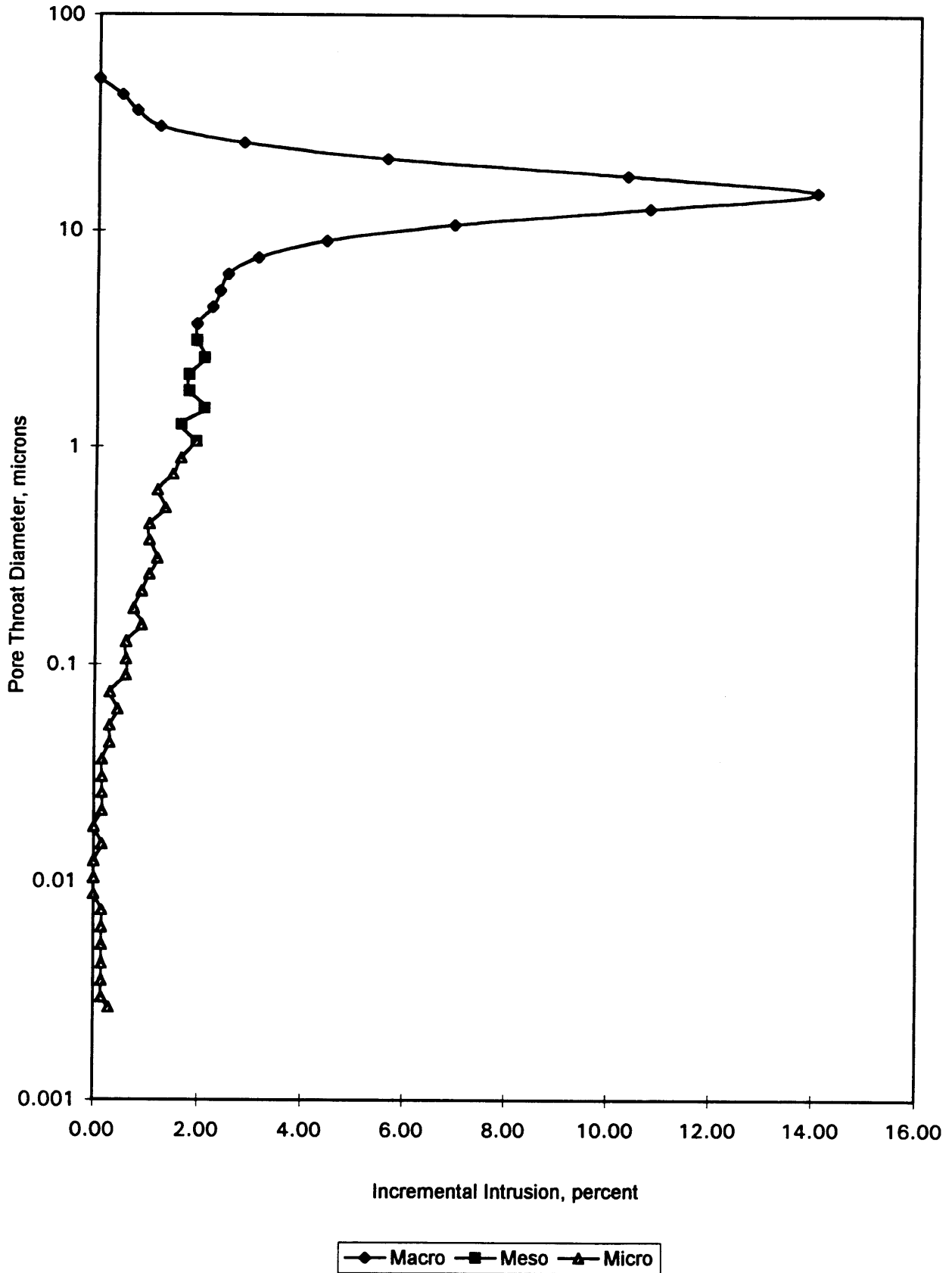


Pore Throat Diameter Vs Incremental Intrusion

Client: BHP Petroleum

Well: Minerva 2A

Sample: 163



CAPILLARY PRESSURE

Company	BHP Petroleum Pty Ltd	Phase: 1c
Well	Minerva 2A	
Test Method	Air/Mercury Capillary Pressure	
Sample Number	216	
Depth	1931.20 metres	

Pressure (psia)	Intrusion percent	Saturation percent	Pore Diameter (μm)
2.08	0.0	0.0	51
2.47	0.1	0.1	43
2.92	0.3	0.4	36
3.47	0.0	0.4	31
4.15	0.3	0.7	26
4.91	0.0	0.7	22
5.86	0.3	1.0	18
6.98	0.1	1.1	15
8.33	0.3	1.4	13
9.94	0.0	1.4	11
11.9	0.3	1.7	8.9
14.2	0.4	2.1	7.5
16.9	0.4	2.5	6.3
20.2	0.4	3.0	5.2
24.1	1.3	4.2	4.4
28.8	4.1	8.4	3.7
34.2	5.8	14.2	3.1
41.2	4.5	18.7	2.6
49.3	4.0	22.7	2.2
58.4	3.5	26.2	1.8
70.2	3.5	29.7	1.5
83.7	3.4	33.1	1.3
100	3.4	36.5	1.1
119	3.5	40.1	0.89

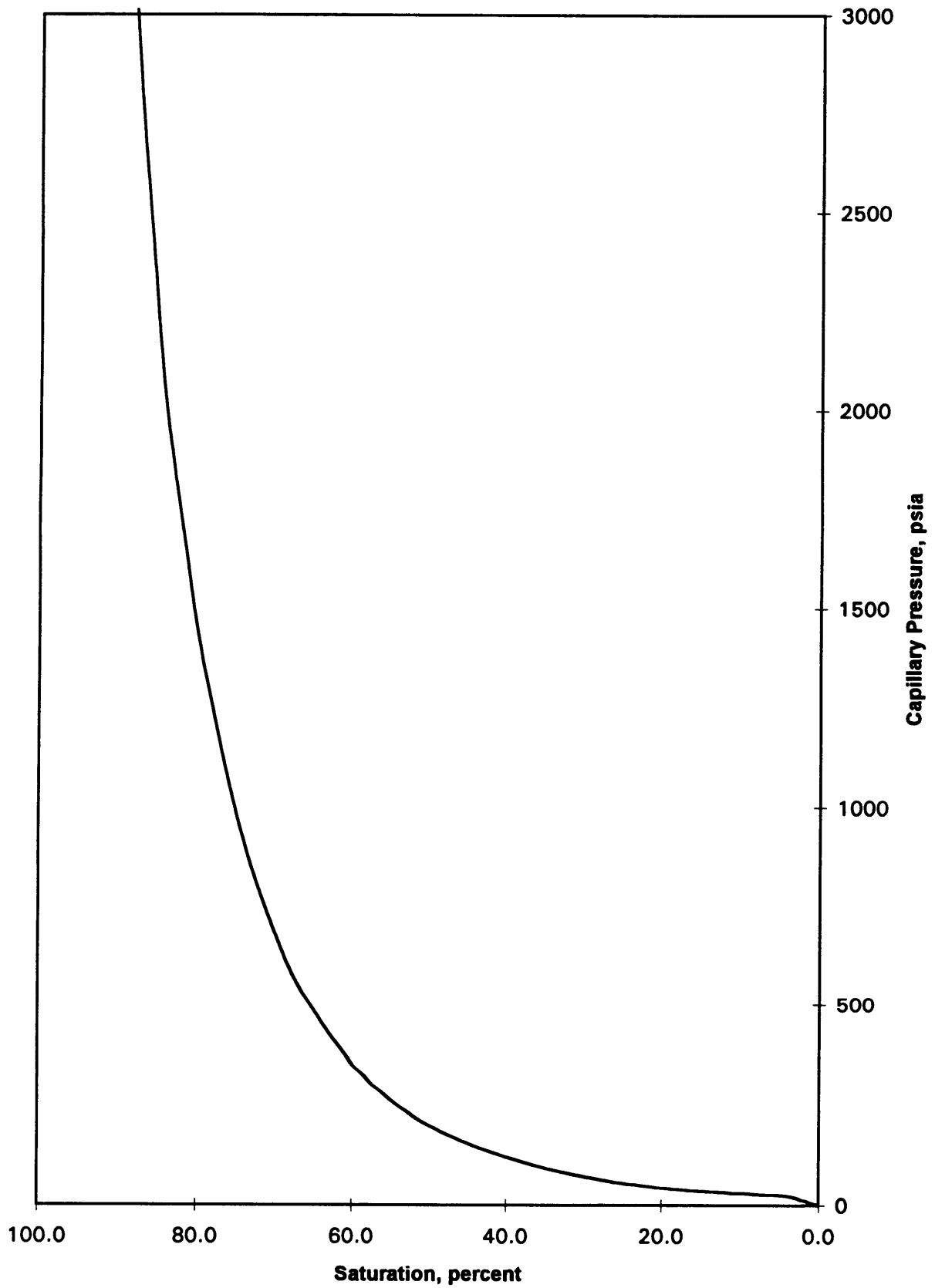
Pressure (psia)	Intrusion percent	Saturation percent	Pore Diameter (μm)
142	3.4	43.5	0.75
168	3.3	46.7	0.63
203	3.7	50.4	0.52
240	3.0	53.4	0.44
287	3.1	56.5	0.37
345	3.1	59.6	0.31
410	2.8	62.5	0.26
490	2.7	65.2	0.22
586	2.7	67.8	0.18
699	2.4	70.3	0.15
836	2.5	72.8	0.13
1003	2.4	75.2	0.11
1197	2.3	77.5	0.089
1428	2.4	79.9	0.074
1712	2.1	82.0	0.062
2045	2.3	84.3	0.052
2450	1.7	86.0	0.043
2927	1.8	87.8	0.036
3521	1.7	89.5	0.030
4178	1.7	91.2	0.025
5027	1.3	92.5	0.021
5990	1.3	93.8	0.018
7157	1.1	94.9	0.015
8563	1.0	95.9	0.012
10236	0.8	96.7	0.010
12231	0.7	97.5	0.009
14624	0.6	98.0	0.007
17486	0.4	98.4	0.006
20916	0.6	99.0	0.005
25012	0.3	99.3	0.004
29896	0.4	99.7	0.004
35747	0.3	100.0	0.003
39772	0.0	100.0	0.003

Capillary Pressure Vs Saturation

Client: BHP Petroleum

Well: Minerva 2A

Sample: 216

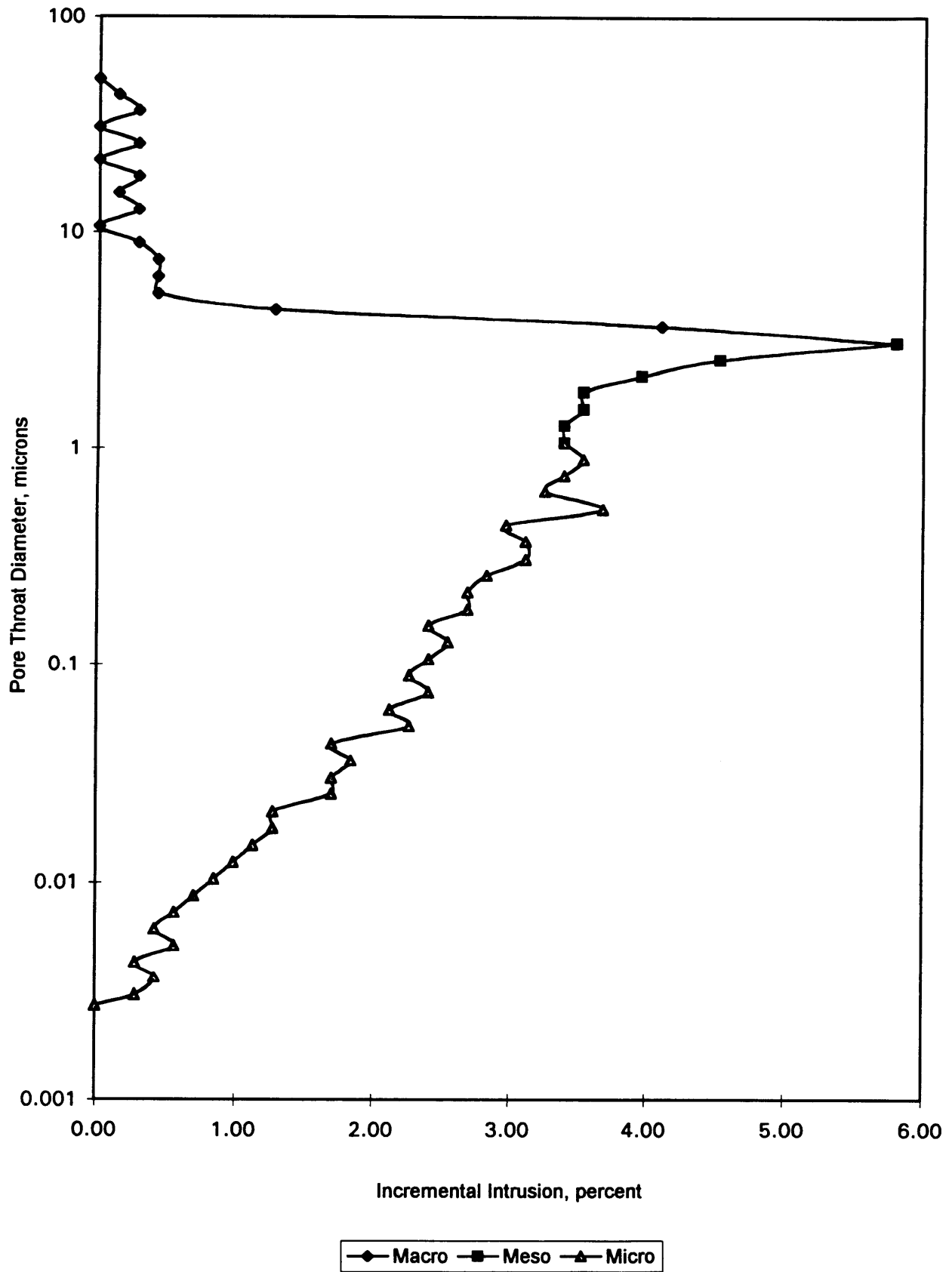


Pore Throat Diameter Vs Incremental Intrusion

Client: BHP Petroleum

Well: Minerva 2A

Sample: 216



CAPILLARY PRESSURE

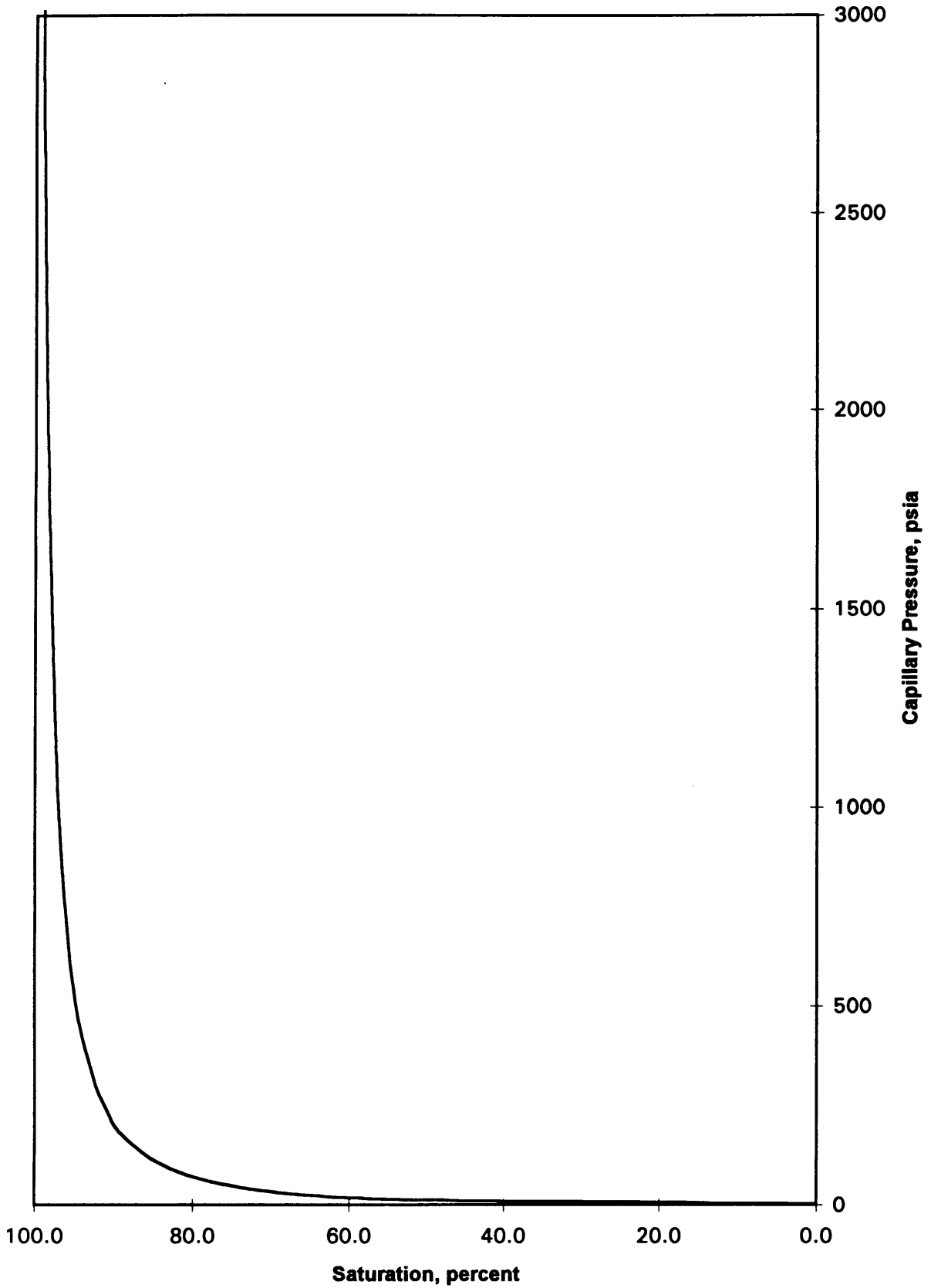
Company	BHP Petroleum Pty Ltd	Phase: 1c
Well	Minerva 2A	
Test Method	Air/Mercury Capillary Pressure	
Sample Number	334	
Depth	1966.70 metres	

Pressure (psia)	Intrusion percent	Saturation percent	Pore Diameter (μm)
1.91	0.0	0.0	55
2.45	0.4	0.4	43
2.92	2.0	2.4	36
3.45	2.9	5.2	31
4.14	4.1	9.3	26
4.91	4.6	13.9	22
5.85	5.1	19.0	18
6.99	7.2	26.2	15
8.33	7.6	33.8	13
9.95	8.7	42.6	11
11.9	6.6	49.1	8.9
14.2	5.2	54.4	7.5
16.9	4.0	58.4	6.3
20.2	3.5	61.8	5.2
24.1	3.0	64.8	4.4
28.9	2.9	67.7	3.7
34.4	2.6	70.3	3.1
41.2	2.5	72.7	2.6
49.0	2.4	75.1	2.2
58.7	2.4	77.5	1.8
70.4	2.2	79.8	1.5
83.7	2.0	81.7	1.3
99.5	1.9	83.6	1.1
119	1.7	85.4	0.89

Pressure (psia)	Intrusion percent	Saturation percent	Pore Diameter (μm)
142	1.5	86.8	0.75
169	1.6	88.5	0.63
203	1.5	90.0	0.52
244	1.0	91.0	0.43
288	1.1	92.1	0.37
346	0.9	92.9	0.31
410	0.9	93.8	0.26
489	0.9	94.7	0.22
594	0.7	95.4	0.18
699	0.5	95.9	0.15
839	0.6	96.6	0.13
1002	0.5	97.1	0.11
1197	0.4	97.4	0.089
1434	0.4	97.8	0.074
1712	0.4	98.2	0.062
2047	0.4	98.5	0.052
2450	0.2	98.8	0.043
2932	0.2	99.0	0.036
3516	0.2	99.3	0.030
4167	0.2	99.5	0.025
5020	0.1	99.7	0.021
6013	0.2	99.9	0.018
7163	0.0	99.9	0.015
8572	0.0	99.9	0.012
10237	0.0	99.9	0.010
12237	0.0	99.9	0.009
14627	0.0	99.9	0.007
17503	0.0	99.9	0.006
20920	0.0	99.9	0.005
25016	0.0	99.9	0.004
29889	0.0	100.0	0.004
35697	0.0	100.0	0.003
39649	0.0	100.0	0.003

Capillary Pressure Vs Saturation

Client: BHP Petroleum
Well: Minerva 2A
Sample: 334

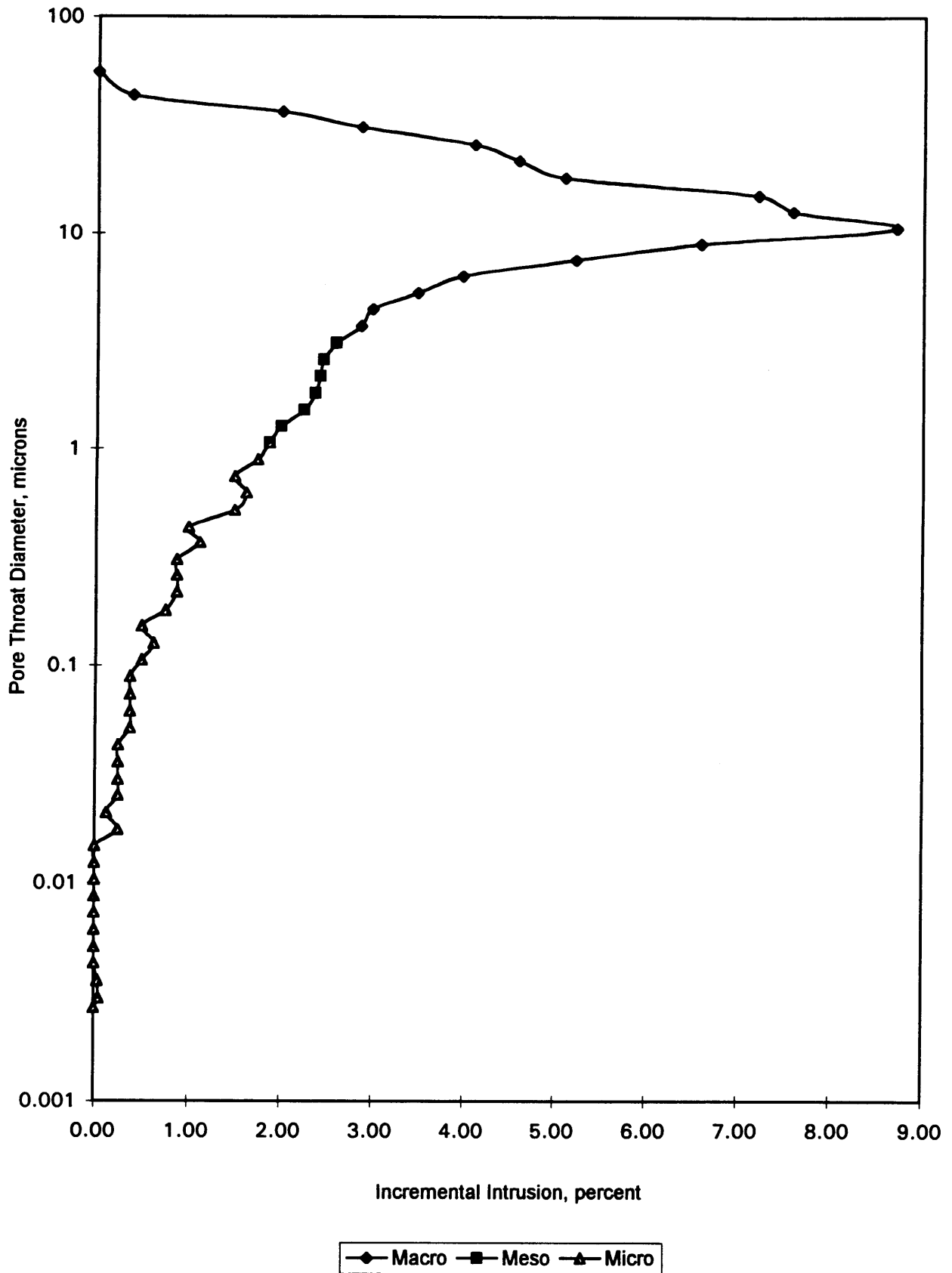


Pore Throat Diameter Vs Incremental Intrusion

Client: BHP Petroleum

Well: Minerva 2A

Sample: 334



CHAPTER 5

Comments on Results

5. COMMENT ON RESULTS

- 5.1 The Gas Permeability data determined as a function of Irreducible Brine Saturation ($K_g @ Swir$) exhibits excellent correlation when plotted K_g v $Swir$. For samples of $K_a > 2D$ the K_a is, broadly speaking, the same as $K_g @ Swir$. This is not a particularly unusual phenomenon. For samples of such high permeability there is sufficient free flow pore space available, even with an immobile phase present, to maintain a constant permeability factor. In some instances (e.g. sample 31) the reported value for $K_g @ Swir$ is greater than K_a . This is clearly theoretically impossible - it is probably a result of attempting to report too accurately, i.e. the data on the K_a of 5981 should be 6000 mD.
- 5.2 The Brine Permeability data determined as a function of Residual Gas Saturation ($K_w @ Sgr$) does not exhibit such direct correlation. Whilst there is a general trend, the graph plot (of K_w relative to K_g versus Sgr) shows more scatter than the $K_g @ Swir$ data set. This is to be expected as K_w data typically shows greater variable characteristics than K_a/K_g data. For example, the more permeable samples are typically characterised by lower $K_a:K_w$ than samples of less permeability.
- 5.3 Upon completion of one set of Centrifuge Capillary Pressure analyses, five samples were re-saturated with brine and re-centrifuged (single point). The resulting data generally compared well:

Sample Number	Initial Swir	Repeat Swir	Initial Sgr	Repeat Sgr
43	24.7	30.5	30.0	26.4
61	5.8	10.1	27.8	19.2
153	8.1	8.8	23.7	20.4
266	28.7	36.1	18.7	25.5
306	55.9	67.7	16.1	15.7

- 5.4 The $Swir$ determined by Porous Plate for the six samples prior to waterflood generally exhibit similar values than those previously derived by centrifugation.

Sample Number	Centrifuge Swir	Porous Plate Swir
50	10.2	13.7
80	16.2	15.7
122	11.8	8.9
142	36.2	28.0
230	56.5	44.1
283	12.4	13.6

- 5.5 The waterfloods result in average gas recoveries of 55% pore space, 70% gas in place. The data for sample 230 is atypical; the Sgr of 8.8% is very low and does not compare to the other samples. Whilst the number has been verified, the data set is inconsistent with previous determined values, e.g. Kw @ Sgr by waterflooding is 0.52 @ 91.2% Sw, previous Kw @ Sgr is 0.61 @ 63.4% Sw.
- 5.6 Upon completion of the waterflooding the samples were centrifuged to evaluate comparative Sgr. It is noted that, except for sample 230, the Sgr were significantly reduced by centrifugation. This may be attributed to the different mechanisms employed to derive these data.

APPENDIX 1

Specifications of Fluids Used During Analyses

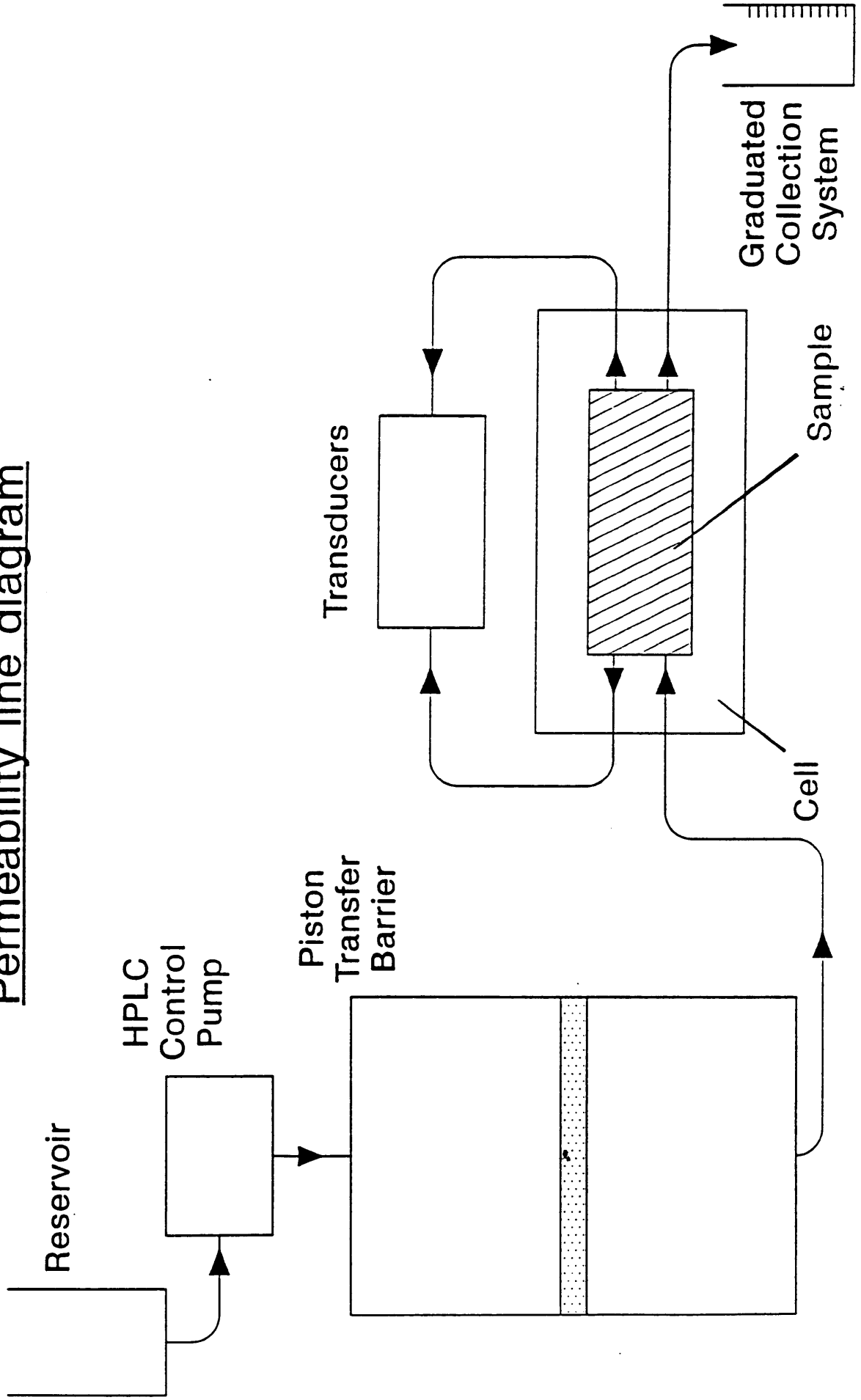
BRINE COMPOSITION

Density @ 25°C = 1.027

<i>Component</i>	<i>g/litre</i>
NaCl	39.03
Distilled H ₂ O	988.17

APPENDIX 2
Equipment Drawing

Permeability line diagram



Hydrostatic core holder

