AMDEL
CORE
SERVICES
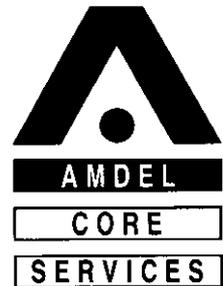
19 August 1991

The Shell Company of Australia
Exploration and Production
Level 19, 1 Spring Street
MELBOURNE VIC 3000

Attention: Mr Mark Trupp

REPORT: 008/105

CLIENT REFERENCE:	ITC #48340/EXO
MATERIAL:	Core Sample
LOCALITY:	Bass Basin
WORK REQUIRED:	High Pressure Mercury Injection

Please direct technical enquiries regarding this work to the signatory below under whose supervision the work was carried out.

RUSSELL R MARTIN
Laboratory Supervisor
Core Analysis/Special Core Analysis
on behalf of Amdel Core Services Pty Ltd

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1. INTRODUCTION

Seven samples in total - two from the Bass #2 well (3800, 3819 ft), one from the Bass #3 well (5027 ft), three from the Cormorant #1 well (3800, 3818, 4272 ft) and one outcrop sample - were provided by Shell Australia for the determination of seal capacity using the Micromeritics Autopore 9200. An appropriately sized sub-sample was taken from the section of slabbed core provided and dried at 95°C in a vacuum oven. A further section of core was removed for thin section and petrographic analysis.

The sample size for the Autopore 9200 is selected so that the estimated pore volume is less than the capillary volume of the penetrometer. Prior to commencing the sample run, the sample is evacuated to a pressure less than the equivalent of 50 micro-metres of mercury. Once this has been achieved mercury fills the penetrometer and surrounds the sample. At the predefined pressure points, equilibration is obtained before a reading of the capacitance of the penetrometer capillary is taken, which is then converted into an equivalent intrusion volume.

2. APPARATUS

The mercury injection apparatus used is a semi-automatic Micromeritics Autopore 9200 which will operate up to a pressure of 60,000 psia and measure mercury intrusions as small as 0.00001 cc. It does this by measuring the capacitance change between a capillary of mercury and an outer metal sheath as pressure rises and mercury enters the pores of the sample from the capillary. For pressures up to 24 psia, air pressure is used. Hydraulic oil is used for the higher pressures. No volume corrections for pressure effects on the equipment are made. They are assumed negligible for pressures below 24 psia. For higher pressures the penetrometer experiences equal external and internal pressures and mercury compression is assumed to be offset by penetrometer compression.

In the laboratory tests we are examining seals on a microscale. Macro properties such as faulting, fracturing, thickness and lateral variation cannot be accounted for.

Watts (1987) defined two types of seal - those that fail by capillary leakage (membrane seals) and those which have capillary entry pressures so high that seal failure preferentially occurs by fracturing and/or wedging open of faults (hydraulic seals).

Stratigraphic units identified as having the capillary properties of seals need to be examined carefully prior to sampling for lithological uniformity. If the unit changes laterally, then it is important to measure the capillary properties of the "weak link", ie the least effective seal.

Thickness of the seal should also be considered. A unit containing a thin shale (a few inches thick) can theoretically trap a large column height of hydrocarbon, but the chance that the unit will not contain fractures or some other migration pathways is slim.

Ductility is also an important general consideration. Brittle rocks will tend to fracture rather than flow under regional stress. The following table from Downey 1984 lists lithologies in order of ductility.

- Salt
- Anhydrite
- Kerogen Rich Shales
- Clay Shales
- Silty Shales
- Carbonate Mudstone
- Cherts

3. DISCUSSION OF RESULTS

From the data, porosity can be calculated using the following equation:

Apparent skeletal density   = 2.49 g/ml
Total Intrusion Volume (TIV)   = 0.053403 ml/g

From density therefore:- grain volume in 1 grm of sample = 0.39562

$$\text{Grain Volume} = \frac{\text{Bulk Volume x Bulk Density}}{\text{Skeletal Density}}$$

$$\text{Porosity} = \frac{\text{Bulk Volume - Grain Volume}}{\text{Bulk Volume}}$$

Note: Bulk volume is sometimes referred to as the sample volume.

For Column Height Determination:

If you examine the diameter versus incremental intrusion curve and draw a line from the first major peak to the X-axis (diameter microns) you obtain the breakthrough diameter. The breakthrough diameter refers to the pressure at which a continuous filament of mercury, oil or gas forms in that sample.

The following values were obtained using this method.

Sample ID	Breakthrough Diameter (microns)
Bass 2-1	2.9
Bass 2-2	5.2
Bass 3	0.20
Cormorant 1-1	0.13
Cormorant 1-2	0.52
Cormorant 1-3	0.060
Outcrop	30

The breakthrough pressure can then be calculated from the equation:

$$D = \frac{4 \, \gamma \, Cos\theta}{6.8948 \, P}$$

where: γ = Surface tension of mercury (avg = 484 dynes/cm)

θ = Mercury contact angle (= 153o)

D = Pore Diameter

P = Breakthrough pressure

6.8948 = conversion from kPa to psi

The capillary breakthrough pressure for a hydrocarbon system, at subsurface conditions can be calculated using the following equation:-

$$Pc_{h/w} = \frac{\gamma_{h/w} \times cos\theta_{h/w}}{\gamma_{m/a} \times cos\theta_{m/a}} \times Pc_{m/a}$$

where : $Pc_{h/w}$ = breakthrough pressure for hydrocarbon/water system - psia

$Pc_{m/a}$ = breakthrough pressure for mercury/air system - psia

$\gamma_{h/w}$ = subsurface interfacial tension of hydrocarbon/water

$\gamma_{m/a}$ = interfacial tension of mercury/air

$\theta_{h/w}$ = contact angle of hydrocarbon/water system

$\theta_{m/a}$ = contact angle of mercury/air

To convert to an oil - water system :

$Pc_{m/a}$ = 1,250 psia

$\gamma_{m/a}$ = 484 dynes/cm

$Cos\theta_{m/a}$ = -0.8910

$\gamma_{h/w}$ = 30 dynes/cm

$Cos\theta_{h/w}$ = 1.0

which for this sample from Bass No. 3, gives a $Pc_{h/w}$ of 87.0 psia.

The column height of hydrocarbons that this seal could support can be determined from the following equation (assuming standard values for the water/oil gradients).

$$\text{Column height} = \frac{Pcheight_{hw}}{\rho w - \rho o}$$

where: ρw = water gradient (0.44 psi/ft)

ρo = oil gradient (0.33 psi/ft)

$$\therefore \text{column height} = \frac{87.0}{0.11} = 790 \text{ feet}$$

If you should have any questions concerning the data presented in this Report please do not hesitate to contact Russell Martin on (08) 372-2724

References

Watts, N.L., 1987, Theoretical aspects of cap-rock and Fault Seals for Two Phase Hydrocarbon Columns: Marine and Petroleum Geology, Vol. 4 pp. 274-307.

Downey, M.W., 1984, Evaluating seals for Hydrocarbon Accumulations: AAPG bulletin, Vol.68, pp. 1752-1763.

Other References

Berg, R.R., 1975, Capillary Pressures in Stratigraphic Traps: AAPG bulletin, Vol. 59 pp. 939-956.

England, W.A., Mackenzie, A.S., et al 1987, The Movement and Entrapment of Petroleum Fluids in The Subsurface: Jrnl. Geol. Soc. Lon., Vol. 63, pp. 327-347.

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AAPG. Treatise of Petroleum reprint series, No.7. 1988, Traps and Seals II, Stratigraphic/Capillary traps:

19 August 1991

MERCURY INJECTION DATA

Company	Shell Australia
Well	Bass No. 2

Sample	Bass 2-1
Depth	3808 ft
Porosity	0.133 (fractional)
Bulk Density	2.13 g/cc
Sample Volume	1.678 cc
Skeletal Density	2.46 g/cc
Total Intrusion	0.061922 cc/g

Table I

Pressure psia	Cumulative Intrusion (ml)	Cumulative Intrusion (%)	Incremental Intrusion (%)	Pore Diameter (μm)	Incremental Volume (ml/g)
2.47	0.00160	0.717746			
2.91	0.00206	0.924098	0.206352	85.97571	0.000128
3.44	0.00266	1.19325	0.269154	72.72945	0.000167
4.07	0.00323	1.44895	0.255697	61.47157	0.000159
4.82	0.00364	1.63287	0.183922	51.90649	0.000114
5.73	0.00476	2.13529	0.502422	43.66305	0.000313
6.77	0.00698	3.13117	0.995872	36.95558	0.000621
8.04	0.00867	3.88929	0.758119	31.11807	0.000472
9.54	0.00929	4.16741	0.278126	26.22529	0.000173
11.33	0.01012	4.53974	0.372330	22.08202	0.000232
13.44	0.01120	5.02422	0.484478	18.61527	0.000302
15.97	0.01174	5.26646	0.242239	15.66620	0.000151
18.97	0.01317	5.90795	0.641485	13.18868	0.000400
21.92	0.01387	6.22196	0.314013	11.41374	0.000195
24.94	0.01429	6.41037	0.188408	10.03164	0.000117
28.50	0.01513	6.78719	0.376816	8.77857	0.000235
30.19	0.01536	6.89036	0.103176	8.28716	0.000064
36.12	0.01712	7.67988	0.789520	6.92661	0.000492
43.61	0.01782	7.99390	0.314013	5.73697	0.000195
52.17	0.01918	8.60398	0.610084	4.79565	0.000380
62.42	0.02061	9.24547	0.641485	4.00816	0.000400
74.75	0.02199	9.86452	0.619056	3.34701	0.000386
89.03	0.02362	10.5957	0.731204	2.81017	0.000456
106.63	0.02590	11.6185	1.02279	2.34633	0.000637
126.59	0.02858	12.8207	1.20222	1.97638	0.000749
150.72	0.03198	14.3460	1.52521	1.65996	0.000951
178.75	0.03587	16.0910	1.74502	1.39966	0.001088
213.68	0.04098	18.3833	2.2923	1.17086	0.001429
253.64	0.04704	21.1017	2.71846	0.98634	0.001695

Table I (continued)

Pressure psia	Cumulative Intrusion (ml)	Cumulative Intrusion (%)	Incremental Intrusion (%)	Pore Diameter (μm)	Incremental Volume (ml/g)
292.04	0.05152	23.1114	2.00969	0.856695	0.001253
357.50	0.05982	26.8347	3.72331	0.699830	0.002322
425.51	0.06528	29.2840	2.44931	0.587975	0.001527
503.64	0.07011	31.4507	2.16670	0.496762	0.001351
601.99	0.07518	33.7251	2.27436	0.415603	0.001418
717.79	0.07924	35.5464	1.82128	0.348555	0.001135
852.51	0.08333	37.3811	1.83474	0.293473	0.001144
1012.03	0.08737	39.1934	1.81231	0.247215	0.001130
1204.33	0.09149	41.0416	1.84820	0.207741	0.001152
1431.69	0.09597	43.0513	2.00969	0.174751	0.001253
1704.07	0.10060	45.1283	2.07698	0.146818	0.001295
2022.13	0.10554	47.3443	2.21604	0.123725	0.001382
2397.59	0.11044	49.5424	2.19810	0.104350	0.001370
2860.96	0.11639	52.2116	2.66912	0.087449	0.001664
3419.43	0.12284	55.1050	2.89341	0.073166	0.001804
4055.18	0.12960	58.1374	3.03248	0.061696	0.001891
4856.40	0.13759	61.7217	3.58424	0.051517	0.002235
5774.82	0.14580	65.4046	3.68293	0.043324	0.002297
6831.95	0.15592	69.9444	4.53974	0.036620	0.002831
8152.17	0.16648	74.6815	4.73712	0.030689	0.002954
9682.86	0.17770	79.7147	5.03320	0.025838	0.003139
11512.5	0.18903	84.7972	5.08254	0.021731	0.003169
13681.8	0.19899	89.2652	4.46797	0.018286	0.002786
16274.4	0.20810	93.3519	4.08667	0.015373	0.002548
19347.8	0.21667	97.1963	3.84443	0.012931	0.002397
23126.7	0.22292	100	2.80370	0.010818	0.001748

Figure 1

Cumulative Intrusion vs Pressure

Bass 2   Depth 3808'

250011

Porosity: 0.133 (fractional)
Skeletal Density: 2.46 (g/cc)
Bulk Density: 2.13 (g/cc)
Bulk Volume: 1.678 (cc)
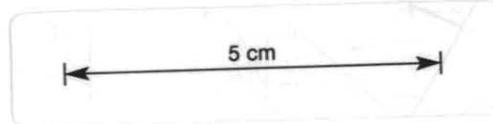Total Intrusion: 0.061922 (cc/g)

Percent of Total Intrusion

Pressure (psia)

008/105 Bass Basin

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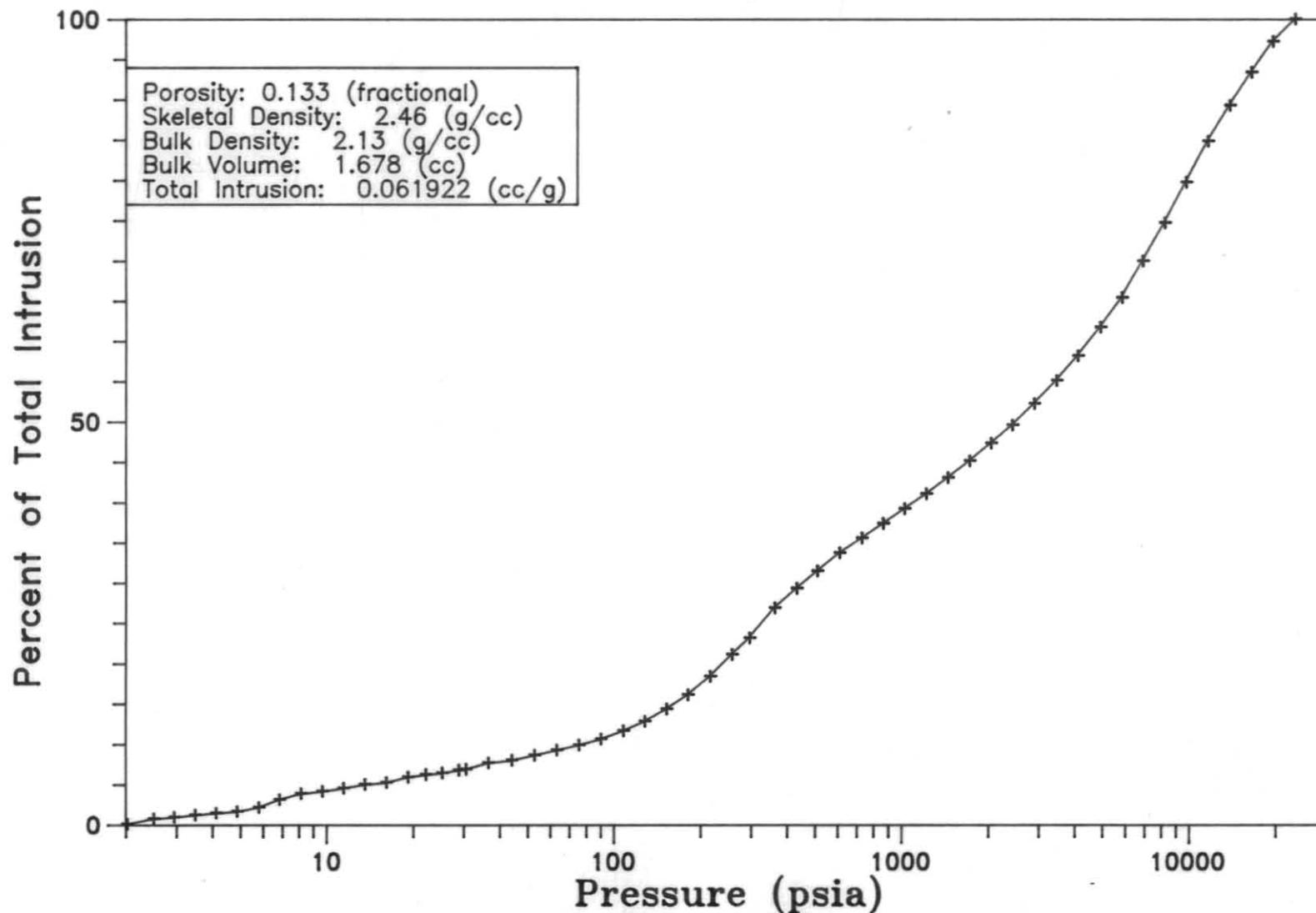
Figure 2

250012

Pore Radius vs Incremental Intrusion
Bass 2   Depth 3808'

Porosity: 0.133 (fractional)
Skeletal Density: 2.46 (g/cc)
Bulk Density: 2.13 (g/cc)
Bulk Volume: 1.678 (cc)
Total Intrusion: 0.061922 (cc/g)
Breakthrough Diameter 2.9 (microns)

5 cm

8
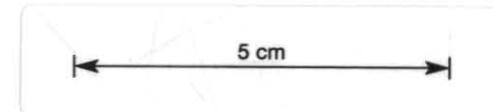
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MERCURY INJECTION DATA

Company	Shell Australia
Well	Bass No. 2

Sample	Bass 2-2
Depth	3819 ft
Porosity	0.157 (fractional)
Bulk Density	2.08 g/cc
Sample Volume	1.750 cc
Skeletal Density	2.47 g/cc
Total Intrusion	0.075453 cc/g

Table II

Pressure psia	Cumulative Intrusion (ml)	Cumulative Intrusion (%)	Incremental Intrusion (%)	Pore Diameter (μm)	Incremental Volume (ml/g)
2.47	0.00075	0.272331			
2.88	0.00191	0.693536	0.421205	86.87129	0.000318
3.43	0.00283	1.02760	0.334059	72.94149	0.000252
4.08	0.00421	1.52868	0.501089	61.32091	0.000379
4.82	0.00494	1.79375	0.265068	51.90649	0.000200
5.71	0.00588	2.13508	0.341321	43.81599	0.000258
6.78	0.00782	2.83951	0.704429	36.90107	0.000532
8.03	0.00830	3.01380	0.174291	31.15682	0.000131
9.54	0.00940	3.41322	0.399419	26.22529	0.000302
11.30	0.01023	3.71460	0.301379	22.14064	0.000228
13.44	0.01106	4.01598	0.301379	18.61527	0.000228
15.98	0.01203	4.36819	0.352214	15.65640	0.000266
18.96	0.01304	4.73493	0.366739	13.19563	0.000277
21.95	0.01444	5.24328	0.508351	11.39814	0.000384
24.92	0.01510	5.48293	0.239651	10.03969	0.000181
28.51	0.01611	5.84967	0.366739	8.775493	0.000277
30.74	0.01652	5.99855	0.148874	8.138884	0.000112
36.73	0.01819	6.60494	0.606390	6.811579	0.000458
44.22	0.01981	7.19317	0.588235	5.657831	0.000445
52.96	0.02183	7.92665	0.733478	4.724118	0.000554
63.31	0.02405	8.73275	0.806100	3.951813	0.000609
75.45	0.02771	10.0617	1.32898	3.315961	0.001005
90.00	0.03239	11.7611	1.69935	2.779881	0.001285
107.55	0.03827	13.8961	2.13508	2.326260	0.001615
127.19	0.04587	16.6558	2.75962	1.967051	0.002087
152.81	0.05586	20.2832	3.62745	1.637257	0.002744
179.79	0.06286	22.8250	2.54176	1.391564	0.001923
214.27	0.07599	27.5926	4.76761	1.167635	0.003607
254.73	0.08349	30.3159	2.72331	0.982174	0.002060

Table II (continued)

Pressure psia	Cumulative Intrusion (ml)	Cumulative Intrusion (%)	Incremental Intrusion (%)	Pore Diameter (μm)	Incremental Volume (ml/g)
291.48	0.08876	32.2295	1.91358	0.858341	0.001447
358.24	0.09847	35.7553	3.52578	0.698384	0.002667
423.49	0.10301	37.4038	1.64851	0.590779	0.001247
507.16	0.10942	39.7313	2.32752	0.493314	0.001760
601.76	0.11355	41.2309	1.49964	0.415762	0.001134
719.19	0.11919	43.2789	2.04793	0.347876	0.001549
854.73	0.12378	44.9455	1.66667	0.292711	0.001260
1016.69	0.12880	46.7683	1.82280	0.246082	0.001379
1211.27	0.13390	48.6202	1.85185	0.206551	0.001401
1437.66	0.13932	50.5882	1.96805	0.174025	0.001489
1711.35	0.14509	52.6834	2.09513	0.146194	0.001585
2029.07	0.15122	54.9092	2.22585	0.123302	0.001684
2401.76	0.15791	57.3384	2.42919	0.104169	0.001837
2865.63	0.16553	60.1053	2.76688	0.087306	0.002093
3441.87	0.17418	63.2462	3.14089	0.072689	0.002376
4050.66	0.18254	66.2818	3.03558	0.061765	0.002296
4856.66	0.19255	69.9165	3.63471	0.051514	0.002750
5798.99	0.20223	73.4314	3.51489	0.043143	0.002659
6880.04	0.21295	77.3239	3.89252	0.036364	0.002945
8164.39	0.22377	81.2527	3.92883	0.030643	0.002972
9687.91	0.23374	84.8729	3.62019	0.025824	0.002739
11534.3	0.24471	88.8562	3.98330	0.021690	0.003013
13677.3	0.25422	92.3094	3.45316	0.018292	0.002612
16272.3	0.26230	95.2433	2.93391	0.015375	0.002219
19355.2	0.26952	97.8649	2.62164	0.012926	0.001983
23074.3	0.27540	100	2.13508	0.010842	0.001615

Figure 3

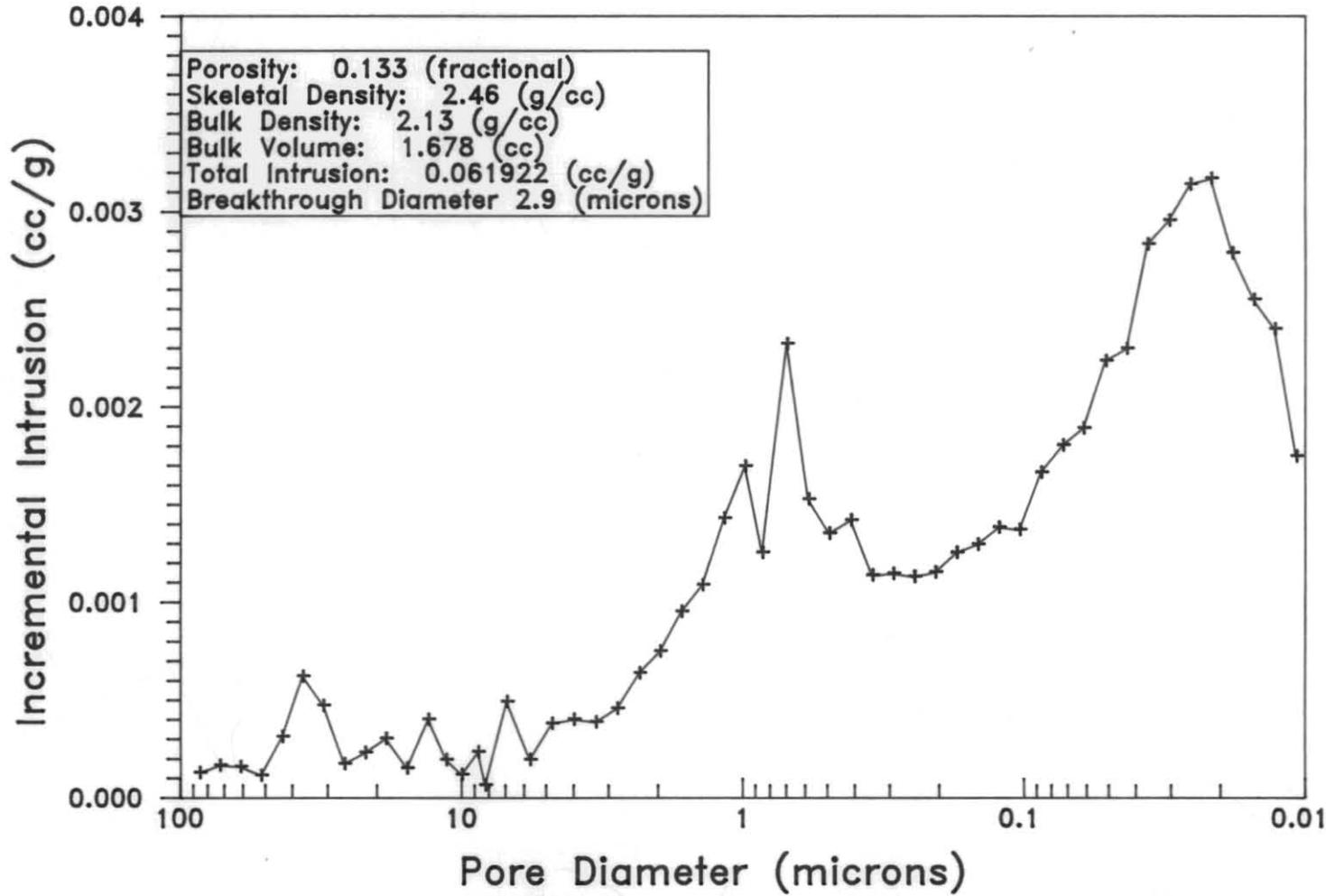# Cumulative Intrusion vs Pressure
Bass 2   Depth 3819'

250015

Porosity: 0.157 (fractional)
Skeletal Density: 2.47 (g/cc)
Bulk Density: 2.08 (g/cc)
Bulk Volume: 1.750 (cc)
Total Intrusion: 0.075453 (cc/g)

008/105 Bass Basin

5 cm
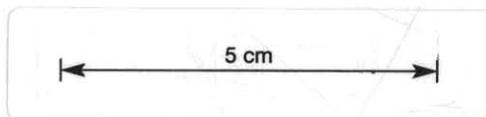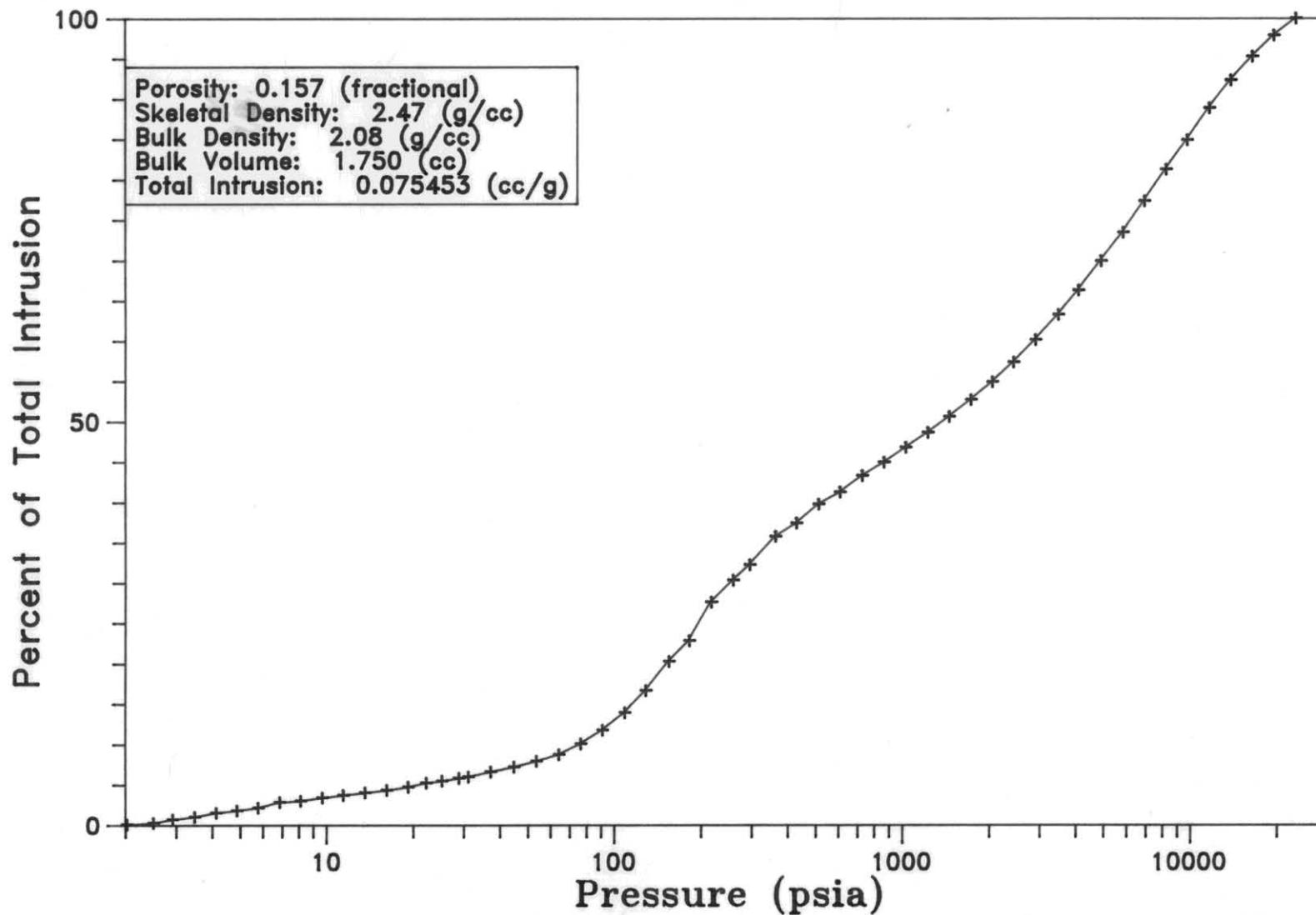
Figure 4

250016

Pore Radius vs Incremental Intrusion
Bass 2   Depth 3819'

Porosity: 0.157 (fractional)
Skeletal Density: 2.47 (g/cc)
Bulk Density: 2.08 (g/cc)
Bulk Volume: 1.750 (cc)
Total Intrusion: 0.075453 (cc/g)
Breakthrough Diameter 5.2 (microns)

5 cm
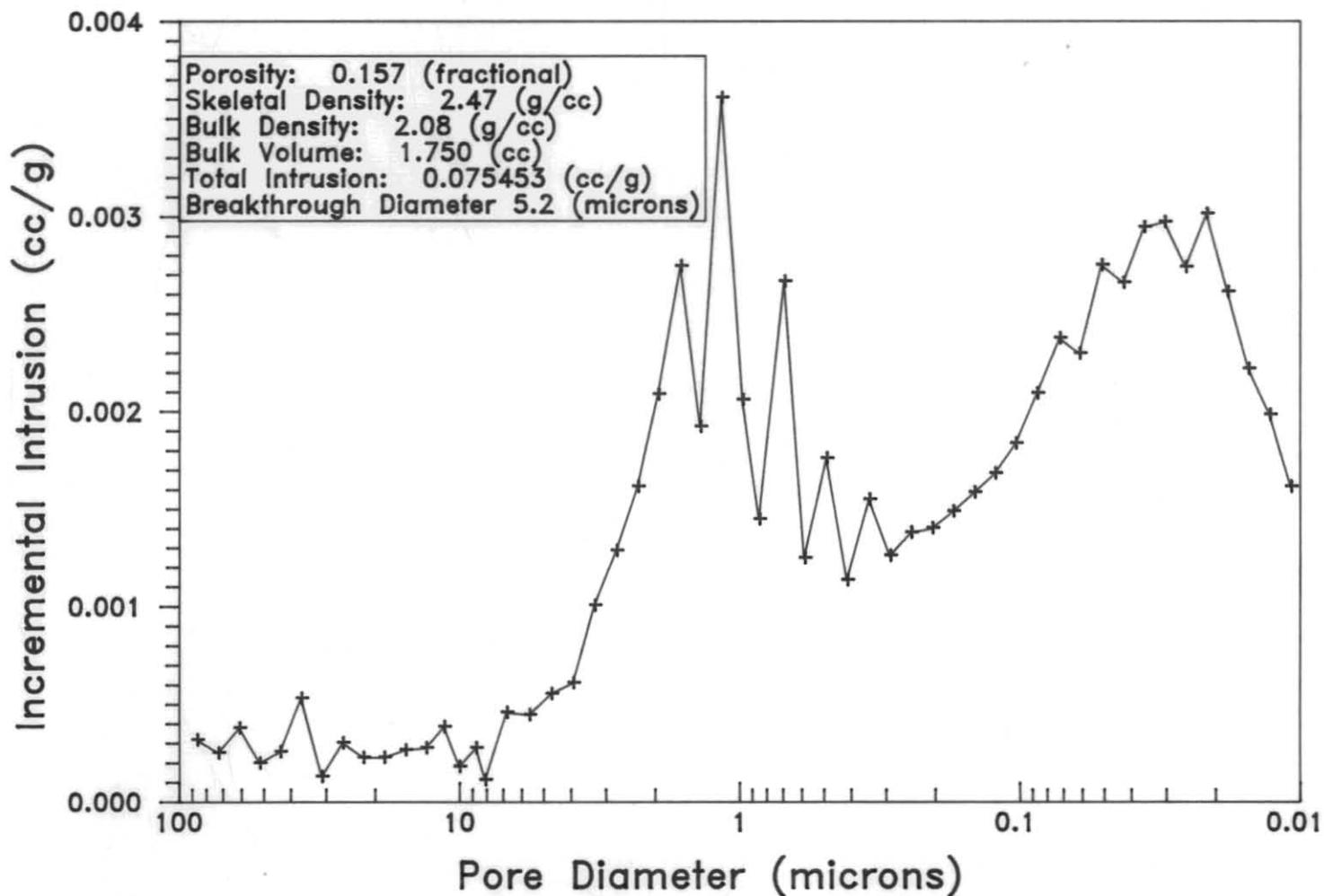
19 August 1991

MERCURY INJECTION DATA

Company	Shell Australia
Well	Bass No. 3

Sample	Bass 3
Depth	5027 ft
Porosity	0.119 (fractional)
Bulk Density	2.19 g/cc
Sample Volume	1.927 cc
Skeletal Density	2.49 g/cc
Total Intrusion	0.053403 cc/g

Table III

Pressure psia	Cumulative Intrusion (ml)	Cumulative Intrusion (%)	Incremental Intrusion (%)	Pore Diameter (μm)	Incremental Volume (ml/g)
2.47	0.00334	1.46036			
2.90	0.00453	1.98067	0.520310	86.27217	0.000281
3.45	0.00642	2.80705	0.82637	72.51864	0.000447
4.06	0.01003	4.38547	1.57842	61.62298	0.000855
4.81	0.01144	5.00197	0.61650	52.01441	0.000334
5.73	0.01386	6.06008	1.05811	43.66305	0.000573
6.78	0.01690	7.38927	1.32919	36.90107	0.000720
8.03	0.01945	8.50422	1.11495	31.15682	0.000604
9.55	0.02288	10.0039	1.49971	26.19783	0.000812
11.31	0.02495	10.9090	0.90508	22.12107	0.000490
13.45	0.02632	11.5080	0.59901	18.60143	0.000324
15.98	0.02882	12.6011	1.09309	15.65640	0.000592
18.95	0.03116	13.6242	1.02313	13.20260	0.000554
21.96	0.03227	14.1096	0.48533	11.39295	0.000263
24.93	0.03463	15.1414	0.62000	10.03567	0.000559
28.51	0.03635	15.8935	0.75204	8.775493	0.000407
30.21	0.04120	16.4700	0.47500	8.281672	0.001149
36.33	0.04169	17.1500	0.21424	6.886576	0.000116
43.35	0.04103	17.9397	0.31000	5.771379	-0.000150
51.29	0.04199	18.3595	0.41974	4.877935	0.000227
61.54	0.04349	19.0153	0.65585	4.065474	0.000355
73.72	0.04507	19.7062	0.69083	3.393778	0.000374
88.54	0.04644	20.3052	0.59901	2.825720	0.000324
105.91	0.04776	20.8823	0.57715	2.362282	0.000312
125.84	0.05031	21.9973	1.11495	1.988154	0.000604
149.97	0.05251	22.9592	0.96191	1.668262	0.000521
178.91	0.05489	23.9998	1.04062	1.398408	0.000563
212.86	0.05788	25.3071	1.30733	1.175370	0.000708
253.84	0.05911	25.8449	0.53780	0.985618	0.000291

Table III (continued)

Pressure psia	Cumulative Intrusion (ml)	Cumulative Intrusion (%)	Incremental Intrusion (%)	Pore Diameter (μm)	Incremental Volume (ml/g)
291.64	0.06043	26.4221	0.57715	0.857870	0.000312
355.92	0.06250	27.3272	0.90508	0.702936	0.000490
424.92	0.06571	28.7307	1.40352	0.588791	0.000760
506.79	0.06730	29.4259	1.45000	0.493674	0.000376
603.35	0.07073	30.9256	1.49971	0.414666	0.000812
718.50	0.07368	32.2155	1.28984	0.348210	0.000699
852.57	0.07654	33.4660	1.25049	0.293453	0.000677
1014.37	0.07927	34.6596	1.19365	0.246645	0.000646
1206.67	0.08318	36.3692	1.70959	0.207338	0.000926
1431.26	0.08679	37.9476	1.57842	0.174803	0.000855
1702.50	0.09084	39.7184	1.77080	0.146954	0.000959
2024.14	0.09498	41.5286	1.81015	0.123602	0.000981
2395.85	0.09841	43.0283	1.49971	0.104426	0.000812
2859.88	0.10334	45.1838	2.15557	0.087482	0.001168
3426.99	0.10946	47.8597	2.67588	0.073005	0.001450
4051.38	0.11597	50.7061	2.84640	0.061754	0.001542
4866.95	0.12345	53.9767	3.27052	0.051405	0.001772
5775.80	0.13256	57.9599	3.98321	0.043316	0.002158
6868.81	0.14250	62.3060	4.34612	0.036423	0.002355
8167.51	0.15359	67.1549	4.84894	0.030632	0.002627
9681.46	0.16636	72.7384	5.58349	0.025842	0.003025
11525.5	0.17833	77.9721	5.23370	0.021707	0.002836
13692.3	0.18832	82.3401	4.36798	0.018272	0.002367
16270.6	0.19703	86.1484	3.80832	0.015376	0.002063
19348.7	0.20429	89.3227	3.17432	0.012930	0.001720
23048.7	0.20997	91.8062	2.48349	0.010854	0.001345
27404.0	0.21432	93.7082	1.90197	0.009129	0.001030
32555.7	0.21943	95.9425	2.23427	0.007684	0.001210
38645.0	0.22308	97.5384	1.59591	0.006474	0.000864
45789.0	0.22638	98.9812	1.44288	0.005463	0.000781
49192.4	0.22871	100	1.01876	0.005085	0.000552

Figure 5

Cumulative Intrusion vs Pressure
Bass 3   Depth 5027'

250019
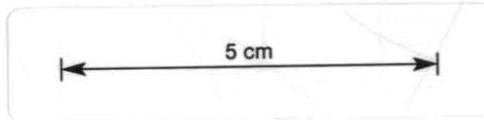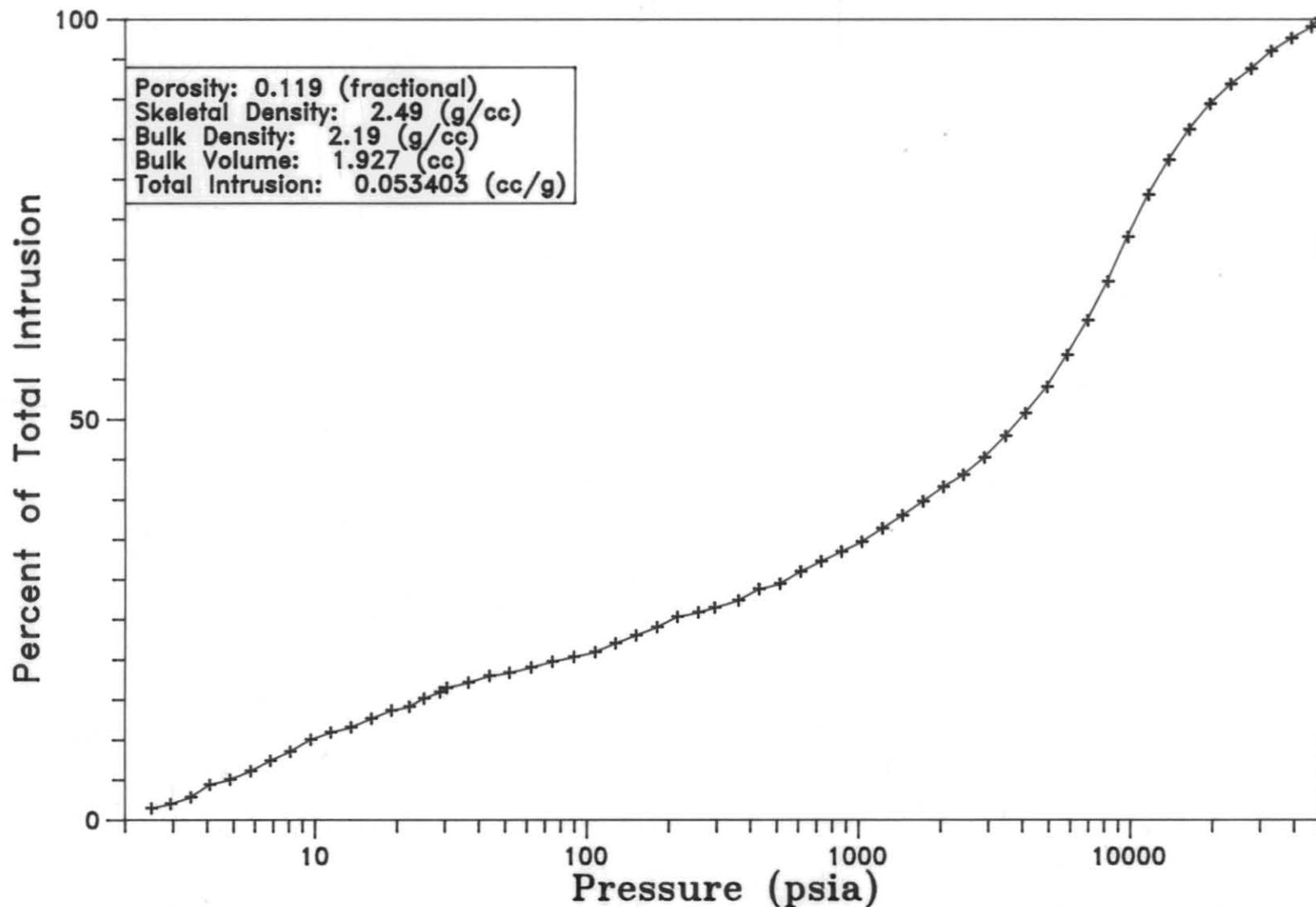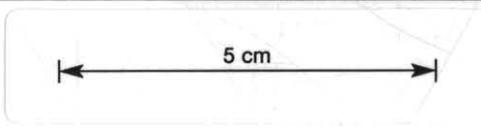
Porosity: 0.119 (fractional)
Skeletal Density: 2.49 (g/cc)
Bulk Density: 2.19 (g/cc)
Bulk Volume: 1.927 (cc)
Total Intrusion: 0.053403 (cc/g)

008/105 Bass Basin

5 cm

Amdel Core Services Pty Limited
(Incorporated in South Australia)

Figure 6

Pore Radius vs Incremental Intrusion
Bass 2   Depth 5027'

250020

Porosity: 0.119 (fractional)
Skeletal Density: 2.49 (g/cc)
Bulk Density: 2.19 (g/cc)
Bulk Volume: 1.927 (cc)
Total Intrusion: 0.053403 (cc/g)
Breakthrough Diameter 0.20 (microns)

008/105 Bass Basin

5 cm

MERCURY INJECTION DATA

Company	Shell Australia
Well	Cormorant No. 1

Sample	Cormorant 1-1
Depth	4272 ft
Porosity	0.0597 (fractional)
Bulk Density	2.96 g/cc
Sample Volume	1.819 cc
Skeletal Density	3.16 g/cc
Total Intrusion	0.023309 cc/g

Table IV

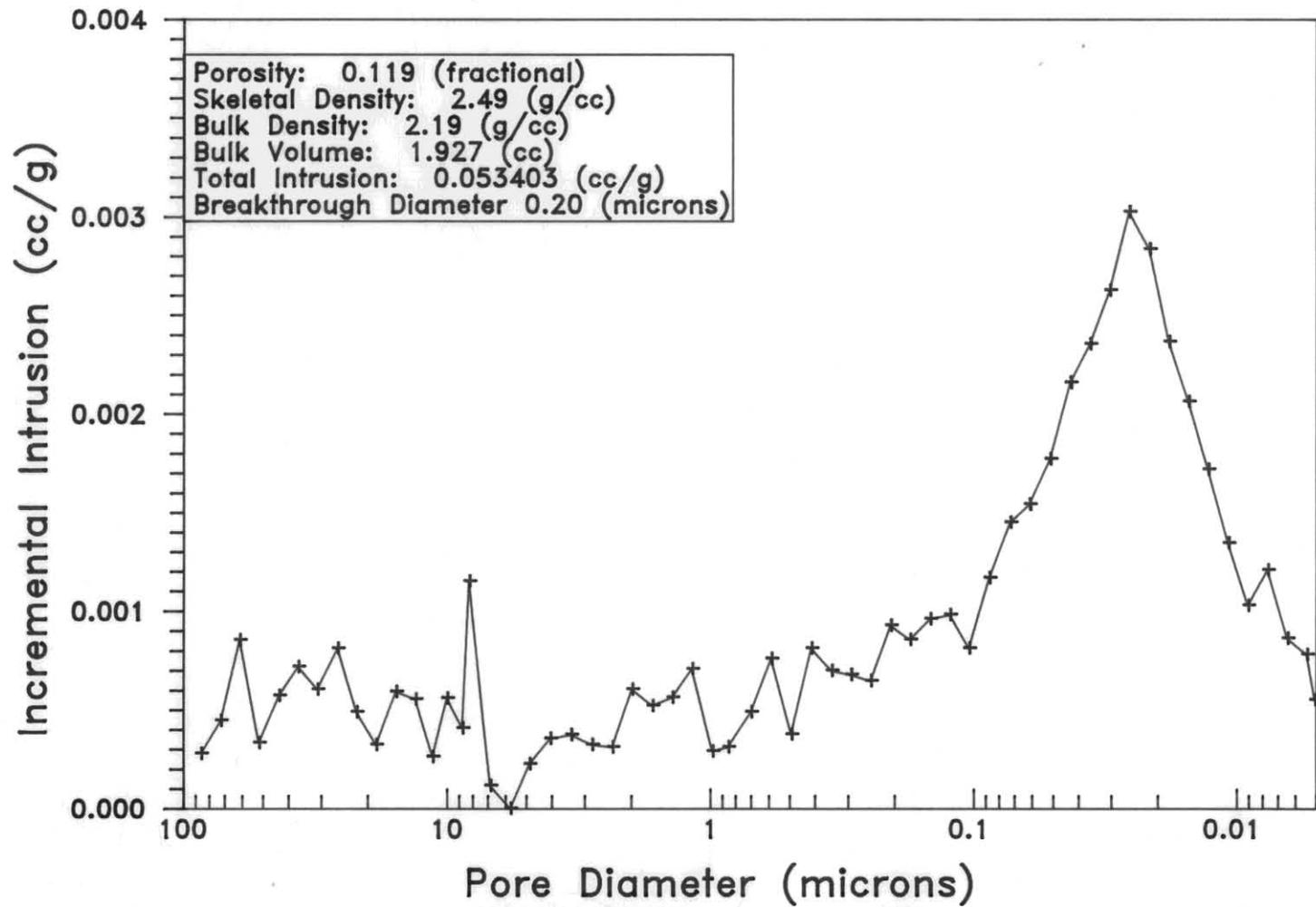| Pressure psia	Cumulative Intrusion (ml)	Cumulative Intrusion (%)	Incremental Intrusion (%)	Pore Diameter (μm)	Incremental Volume (ml/g)
2.47	0.00321	2.49398			
2.91	0.00334	2.59498	0.10100	85.9757	0.00002
3.44	0.00440	3.41854	0.82356	72.7295	0.00020
4.07	0.00458	3.55839	0.13985	61.4716	0.00003
4.82	0.00458	3.55839	0.00000	51.9065	0.00000
5.73	0.00488	3.79147	0.23308	43.6631	0.00006
6.77	0.00488	3.79147	0.00000	36.9556	0.00000
8.04	0.00638	4.95688	1.16541	31.1181	0.00028
9.54	0.00647	5.02680	0.06992	26.2253	0.00002
11.33	0.00673	5.22881	0.20200	22.0820	0.00005
13.44	0.00756	5.87367	0.64486	18.6153	0.00015
15.97	0.00765	5.94359	0.06992	15.6662	0.00002
18.97	0.00766	5.95136	0.00777	13.1887	0.00000
21.92	0.00766	5.95136	0.00000	11.4137	0.00000
24.94	0.00827	6.42530	0.47393	10.0316	0.00011
28.50	0.00844	6.55738	0.13208	8.7786	0.00003
30.19	0.00845	6.56515	0.00777	8.2872	0.00000
36.12	0.00862	6.69723	0.13208	6.9266	0.00003
43.61	0.00863	6.70500	0.00777	5.7370	0.00000
52.17	0.00863	6.70500	0.00000	4.7957	0.00000
62.42	0.00871	6.76715	0.06216	4.0082	0.00001
74.75	0.00873	6.78269	0.01554	3.3470	0.00000
89.03	0.00882	6.85261	0.06992	2.8102	0.00002
106.63	0.00882	6.85261	0.00000	2.3463	0.00000
126.59	0.00883	6.86038	0.00777	1.9764	0.00000
150.72	0.00916	7.11677	0.25639	1.6600	0.00006
178.75	0.00955	7.41978	0.30301	1.3997	0.00007
213.68	0.00979	7.60625	0.18647	1.1709	0.00004
253.64	0.00982	7.62955	0.02331	0.98640	0.00001

17

Table IV (continued)

Pressure psia	Cumulative Intrusion (ml)	Cumulative Intrusion (%)	Incremental Intrusion (%)	Pore Diameter (μm)	Incremental Volume (ml/g)
292.04	0.01021	7.93256	0.30301	0.85670	0.00007
357.50	0.01099	8.53858	0.60601	0.69983	0.00014
425.51	0.01131	8.78720	0.24862	0.58798	0.00006
503.64	0.01188	9.23005	0.44286	0.49676	0.00011
601.99	0.01351	10.49646	1.26641	0.41560	0.00030
717.79	0.01505	11.69295	1.19649	0.34856	0.00029
852.51	0.01739	13.51099	1.81804	0.29347	0.00043
1012.03	0.01981	15.39119	1.88020	0.24722	0.00045
1204.33	0.02223	17.27139	1.88020	0.20774	0.00045
1431.69	0.02487	19.3225	2.05112	0.17475	0.00049
1704.07	0.02795	21.7155	2.39298	0.14682	0.00057
2022.13	0.03072	23.8676	2.15212	0.12373	0.00051
2397.59	0.03503	27.2162	3.34861	0.10435	0.00080
2860.96	0.03860	29.9899	2.77368	0.08745	0.00066
3419.43	0.04260	33.0977	3.10776	0.07317	0.00074
4055.18	0.04735	36.7881	3.69047	0.06170	0.00088
4856.40	0.05360	41.6440	4.85588	0.05152	0.00116
5774.82	0.06073	47.1836	5.53959	0.04332	0.00132
6831.95	0.06914	53.7177	6.53407	0.03662	0.00156
8152.17	0.07895	61.3394	7.62179	0.03069	0.00182
9682.86	0.08837	68.6582	7.31878	0.02584	0.00175
11512.5	0.09497	73.7860	5.12781	0.02173	0.00123
13681.8	0.10179	79.0848	5.29873	0.01829	0.00127
16274.4	0.10694	83.0860	4.00124	0.01537	0.00096
19347.8	0.10892	84.6243	1.53834	0.01293	0.00037
23126.7	0.11266	87.5301	2.90576	0.01082	0.00069
32555.7	0.11743	91.2361	3.70601	0.00768	0.00089
38645.0	0.12208	94.8489	3.61277	0.00647	0.00086
45789.0	0.12638	98.1897	3.34084	0.00546	0.00080
49192.4	0.12871	100	1.81027	0.00509	0.00043

Figure 7

Cumulative Intrusion vs Pressure
Cormorant No.1   Depth 4272'

Porosity: 0.0597 (fractional)
Skeletal Density: 3.15 (g/cc)
Bulk Density: 2.96 (g/cc)
Bulk Volume: 1.819 (cc)
Total Intrusion: 0.021356 (cc/g)

008/105 Bass Basin

5 cm

Amdel Core Services Pty Limited
(Incorporated in South Australia)
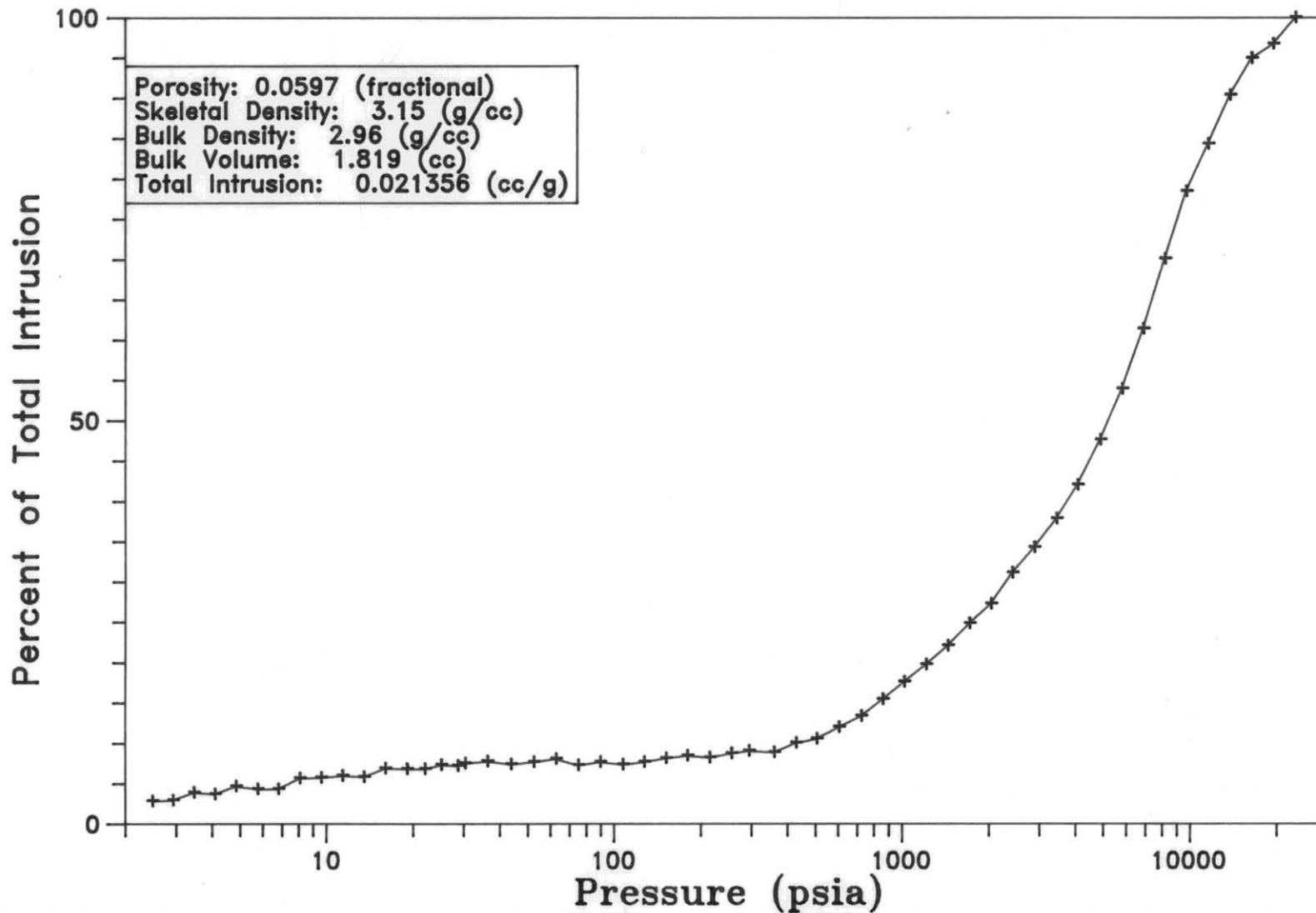
250023

Figure 8

Pore Radius vs Incremental Intrusion
Cormorant No. 1   Depth 4272'

250024
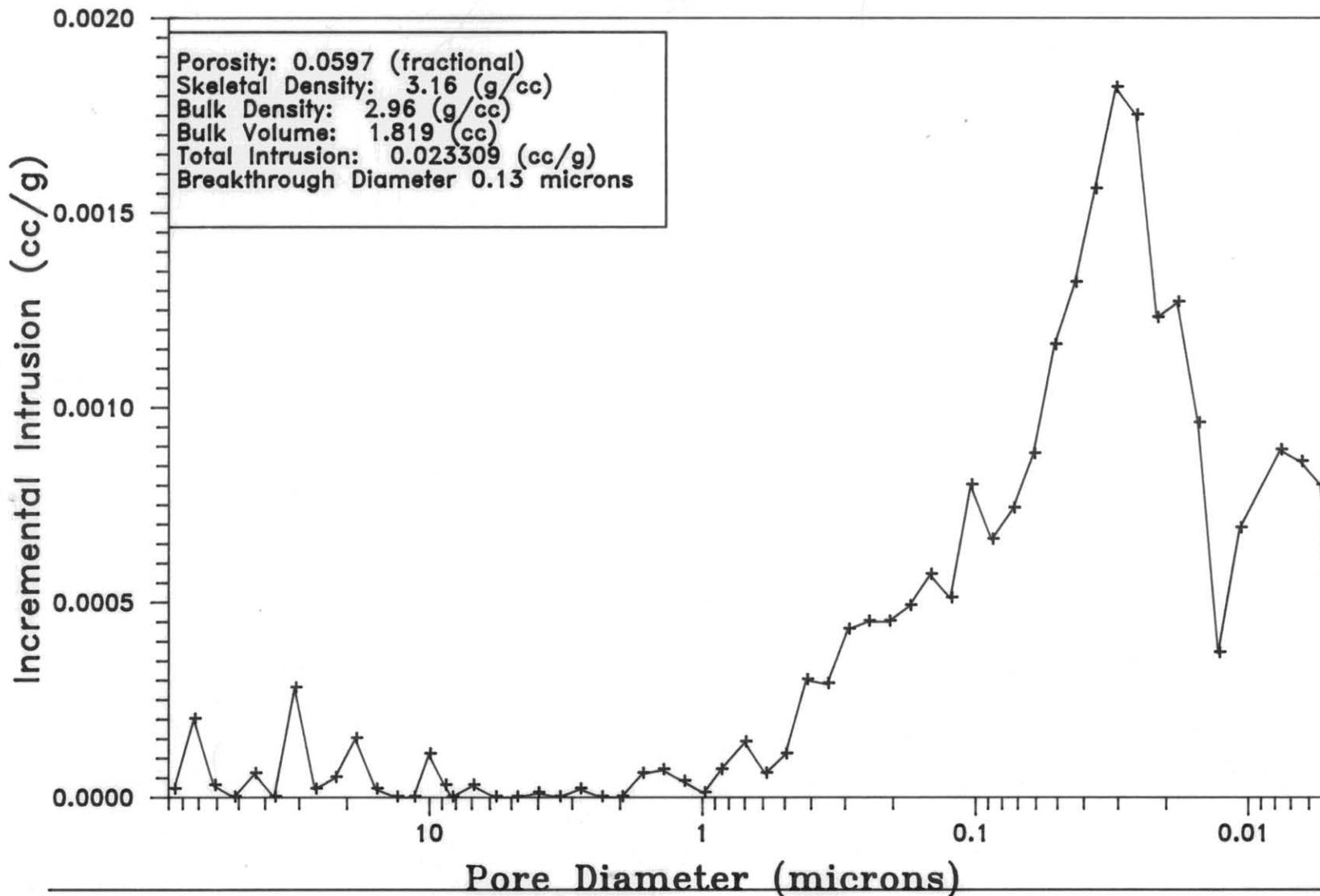
Porosity: 0.0597 (fractional)
Skeletal Density: 3.16 (g/cc)
Bulk Density: 2.96 (g/cc)
Bulk Volume: 1.819 (cc)
Total Intrusion: 0.023309 (cc/g)
Breakthrough Diameter 0.13 microns

Pore Diameter (microns)

008/105 Bass Basin

5 cm

Amdel Core Services Pty Limited
(Incorporated in South Australia)

19 August 1991

MERCURY INJECTION DATA

Company	Shell Australia
Well	Cormorant No. 1

Sample	Cormorant 1-2
Depth	3800 ft
Porosity	0.184 (fractional)
Bulk Density	2.07 g/cc
Sample Volume	2.02 cc
Skeletal Density	2.54 g/cc
Total Intrusion	0.087964

Table V

Pressure psia	Cumulative Intrusion (ml)	Cumulative Intrusion (%)	Incremental Intrusion (%)	Pore Diameter (μm)	Incremental Volume (ml/g)
2.49	0.00134	0.361049			
2.88	0.00255	0.687072	0.326022	86.87129	0.000289
3.44	0.00415	1.11818	0.431104	72.72945	0.000382
4.08	0.00553	1.49000	0.371827	61.32091	0.000329
4.82	0.00711	1.91572	0.425715	51.90649	0.000377
5.73	0.00887	2.38993	0.474214	43.66305	0.000420
6.76	0.01060	2.85607	0.466131	37.01025	0.000413
8.03	0.01278	3.44344	0.587379	31.15682	0.000520
9.53	0.01497	4.03352	0.590073	26.25281	0.000523
11.30	0.01714	4.61820	0.584685	22.14064	0.000518
13.44	0.01967	5.29989	0.681683	18.61527	0.000604
15'.97	0.02202	5.93307	0.633184	15.66620	0.000561
18.95	0.02426	6.53662	0.603545	13.20260	0.000535
21.95	0.02630	7.08627	0.549657	11.39814	0.000487
24.93	0.02803	7.55241	0.466131	10.03567	0.000413
28.51	0.03032	8.16942	0.617017	8.775493	0.000547
30.25	0.03226	8.69214	0.522713	8.270721	0.000463
36.09	0.03455	9.30916	0.617017	6.932372	0.000547
43.62	0.03684	9.92617	0.617017	5.735656	0.000547
51.81	0.03913	10.5432	0.617017	4.828977	0.000547
61.05	0.04220	11.3704	0.827181	4.098105	0.000733
73.26	0.04488	12.0925	0.722099	3.415087	0.000640
87.73	0.04758	12.8200	0.727488	2.851810	0.000645
105.48	0.05074	13.6714	0.851430	2.371912	0.000754
125.56	0.05439	14.6548	0.983456	1.992587	0.000872
149.89	0.05814	15.6652	1.01040	1.669152	0.000895
178.89	0.06207	16.7241	1.05890	1.398565	0.000938
213.21	0.0662	17.8369	1.11279	1.173440	0.000986
254.21	0.07059	19.0198	1.18284	0.984183	0.001048

Table V (continued)

Pressure psia	Cumulative Intrusion (ml)	Cumulative Intrusion (%)	Incremental Intrusion (%)	Pore Diameter (μm)	Incremental Volume (ml/g)
291.19	0.07458	20.0948	1.07507	0.859196	0.000953
.357.44	0.08099	21.8220	1.72711	0.699947	0.001531
424.31	0.08696	23.4305	1.60856	0.589638	0.001426
507.00	0.09421	25.3839	1.95344	0.493470	0.001732
601.44	0.10154	27.3589	1.97500	0.415983	0.001751
718.06	0.11010	29.6653	2.30641	0.348423	0.002045
852.46	0.11906	32.0795	2.41418	0.293490	0.002140
1016.37	0.12966	34.9356	2.85607	0.246159	0.002532
1207.69	0.14143	38.1069	3.17131	0.207163	0.002812
1434.24	0.15543	41.8791	3.77216	0.174440	0.003344
1705.32	0.17172	46.2682	4.38918	0.146711	0.003892
2027.45	0.19038	51.2960	5.02775	0.123400	0.004458
2395.9	0.21053	56.7252	5.42922	0.104423	0.004814
2863.68	0.23161	62.4050	5.67980	0.087366	0.005036
3429.16	0.25378	68.3785	5.97349	0.072959	0.005296
4050.67	0.27288	73.5248	5.14631	0.061764	0.004563
4839.93	0.29209	78.7008	5.17594	0.051692	0.004589
5777.48	0.30925	83.3243	4.62359	0.043304	0.004099
6851.35	0.32497	87.5600	4.23560	0.036516	0.003755
8159.62	0.33953	91.4830	3.92305	0.030661	0.003478
9675.96	0.35298	95.1070	3.62397	0.025856	0.003213
11515.2	0.36471	98.2675	3.16053	0.021726	0.002802
13694	0.37006	99.7090	1.44150	0.018269	0.001278
16269.9	0.37114	100	0.290995	0.015377	0.000258

Figure 9

Cumulative Intrusion vs Pressure
Cormorant No.1   Depth 3800'

250027

Porosity: 0.184 (fractional)
Skeletal Density: 2.54 (g/cc)
Bulk Density: 2.07 (g/cc)
Bulk Volume: 2.02 (cc)
Total Intrusion: 0.087964 (cc/g)

008/105 Bass Basin   5 cm

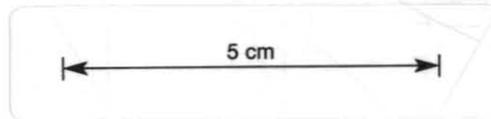Amdel Core Services Pty Limited
(Incorporated in South Australia)
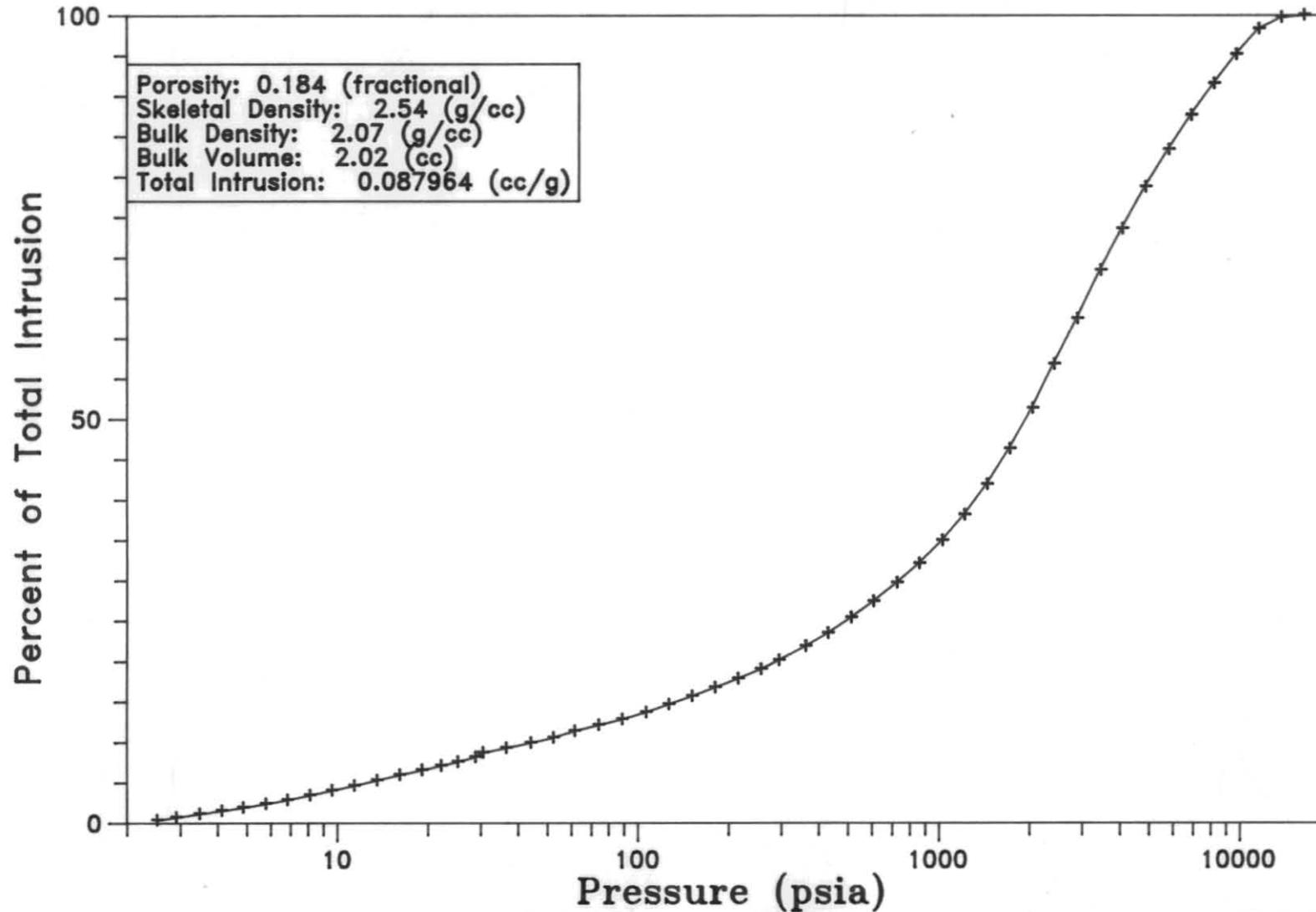
Figure 10

250028

Pore Radius vs Incremental Intrusion
Cormorant No.1   Depth 3800'
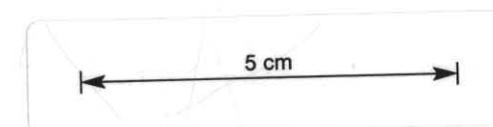
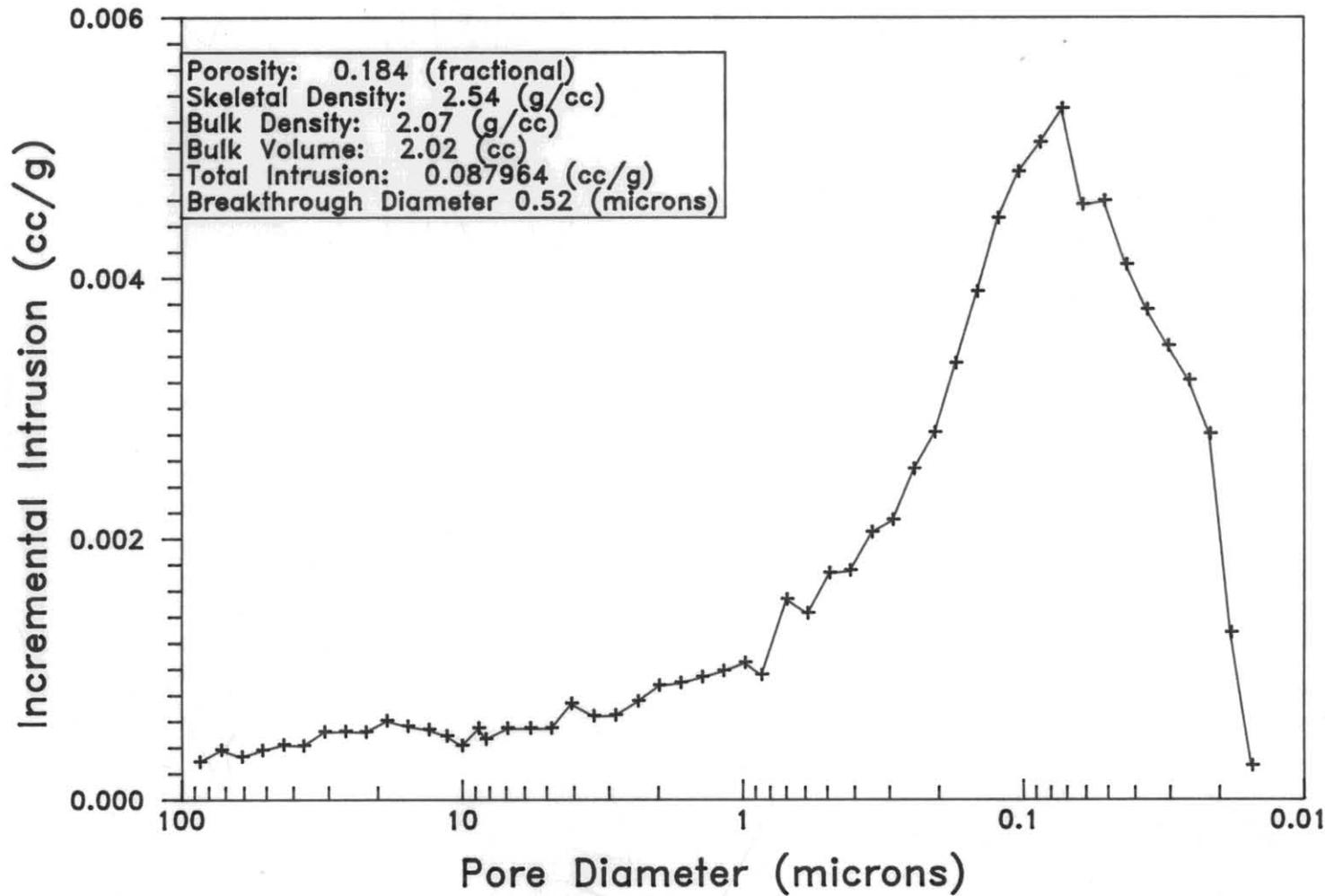Porosity: 0.184 (fractional)
Skeletal Density: 2.54 (g/cc)
Bulk Density: 2.07 (g/cc)
Bulk Volume: 2.02 (cc)
Total Intrusion: 0.087964 (cc/g)
Breakthrough Diameter 0.52 (microns)

Incremental Intrusion (cc/g)

Pore Diameter (microns)

5 cm

19 August 1991

MERCURY INJECTION DATA

Company	Shell Australia
Well	Cormorant No. 1

Sample	Cormorant 1-3
Depth	3818 ft
Porosity	0.0106 (fractional)
Bulk Density	2.17 g/cc
Sample Volume	2.105 cc
Skeletal Density	2.43 g/cc
Total Intrusion	0.004558 cc/g

Table VI

Pressure psia	Cumulative Intrusion (ml)	Cumulative Intrusion (%)	Incremental Intrusion (%)	Pore Diameter (μm)	Incremental Volume (ml/g)
2.48	0.00138	6.2134			
2.90	0.00151	6.7987	0.5853	86.2722	0.00003
3.45	0.00189	8.5097	1.7109	72.5186	0.00008
4.06	0.00209	9.4102	0.9005	61.6230	0.00004
4.81	0.00230	10.3557	0.9455	52.0144	0.00005
5.73	0.00248	11.1661	0.8104	43.6631	0.00004
6.78	0.00261	11.7515	0.5853	36.9011	0.00003
8.03	0.00283	12.7420	0.9905	31.1568	0.00005
9.55	0.00299	13.4624	0.7204	26.1978	0.00004
11.31	0.00314	14.1378	0.6754	22.1211	0.00003
13.45	0.00349	15.7136	1.5759	18.6014	0.00008
15.98	0.00358	16.1189	0.4052	15.6564	0.00002
18.95	0.00360	16.2089	0.0900	13.2026	0.00000
21.96	0.00362	16.2990	0.0900	11.3930	0.00000
24.93	0.00369	16.6141	0.3152	10.0357	0.00002
28.51	0.00366	16.4791	-0.1351	8.7755	-0.00001
30.21	0.00370	16.6592	0.1801	8.2817	0.00001
36.33	0.00370	16.6592	0.0000	6.8866	0.00000
43.35	0.00372	16.7492	0.0900	5.7714	0.00000
51.29	0.00383	17.2445	0.4953	4.8779	0.00002
61.54	0.00381	17.1544	-0.0900	4.0655	-0.00000
73.72	0.00385	17.3345	0.1801	3.3938	0.00001
88.54	0.00392	17.6497	0.3152	2.8257	0.00002
105.91	0.00398	17.9199	0.2701	2.3623	0.00001
125.84	0.00410	18.4602	0.5403	1.9882	0.00003
149.97	0.00410	18.4602	0.0000	1.6683	0.00000
178.91	0.00432	19.4507	0.9905	1.3984	0.00005
212.86	0.00433	19.4957	0.0450	1.1754	0.00000
253.84	0.00434	19.5407	0.0450	0.9856	0.00000

Table VI (continued)

Pressure psia	Cumulative Intrusion (ml)	Cumulative Intrusion (%)	Incremental Intrusion (%)	Pore Diameter (μm)	Incremental Volume (ml/g)
291.64	0.00430	19.3606	-0.1801	0.8579	-0.00001
355.92	0.00446	20.0810	0.7204	0.7029	0.00004
424.92	0.00449	20.2161	0.1351	0.5888	0.00001
506.79	0.00469	21.1166	0.9005	0.4937	0.00004
603.35	0.00469	21.1166	0.0000	0.4147	0.00000
718.50	0.00482	21.7019	0.5853	0.3482	0.00003
852.57	0.00484	21.7920	0.0900	0.2935	0.00000
1014.4	0.00495	22.2873	0.4953	0.2466	0.00002
1206.7	0.00517	23.2778	0.9905	0.2073	0.00005
1431.3	0.00529	23.8181	0.5403	0.1748	0.00003
1702.5	0.00533	23.9982	0.1801	0.1470	0.00001
2024.1	0.00546	24.5835	0.5853	0.1236	0.00003
2395.9	0.00563	25.3489	0.7654	0.1044	0.00004
2859.9	0.00565	25.4390	0.0900	0.0875	0.00000
3427.0	0.00563	25.3489	-0.0900	0.0730	-0.00000
4051.4	0.00563	25.3489	0.0000	0.0618	0.00000
4867.0	0.00596	26.8348	1.4858	0.0514	0.00007
5775.8	0.00599	26.9698	0.1351	0.0433	0.00001
6868.8	0.00664	29.8964	2.9266	0.0364	0.00014
8167.5	0.00732	32.9581	3.0617	0.0306	0.00015
9681.5	0.00785	35.3444	2.3863	0.0258	0.00012
11525.5	0.00891	40.1171	4.7726	0.0217	0.00023
13692.4	0.00978	44.0342	3.9172	0.0183	0.00019
16270.6	0.01101	49.5723	5.5380	0.0154	0.00027
19348.7	0.01237	55.6956	6.1234	0.0129	0.00030
23048.7	0.01369	61.6389	5.9433	0.0109	0.00029
27404.0	0.01569	70.6439	9.0050	0.0091	0.00044
32555.7	0.01758	79.1535	8.5097	0.0077	0.00041
38645.0	0.01962	88.3386	9.1851	0.0065	0.00045
45789.0	0.02111	95.0473	6.7087	0.0055	0.00033
49192.4	0.02221	100	4.9527	0.0051	0.00024

Figure 11

Cumulative Intrusion vs Pressure
Cormorant No.1   Depth 3818'

250031

Porosity: 0.0106 (fractional)
Skeletal Density: 2.43 (g/cc)
Bulk Density: 2.17 (g/cc)
Bulk Volume: 2.105 (cc)
Total Intrusion: 0.004558 (cc/g)

Percent of Total Intrusion

Pressure (psia)

008/105 Bass Basin

5 cm

27

Amdel Core Services Pty Limited
(Incorporated in South Australia)
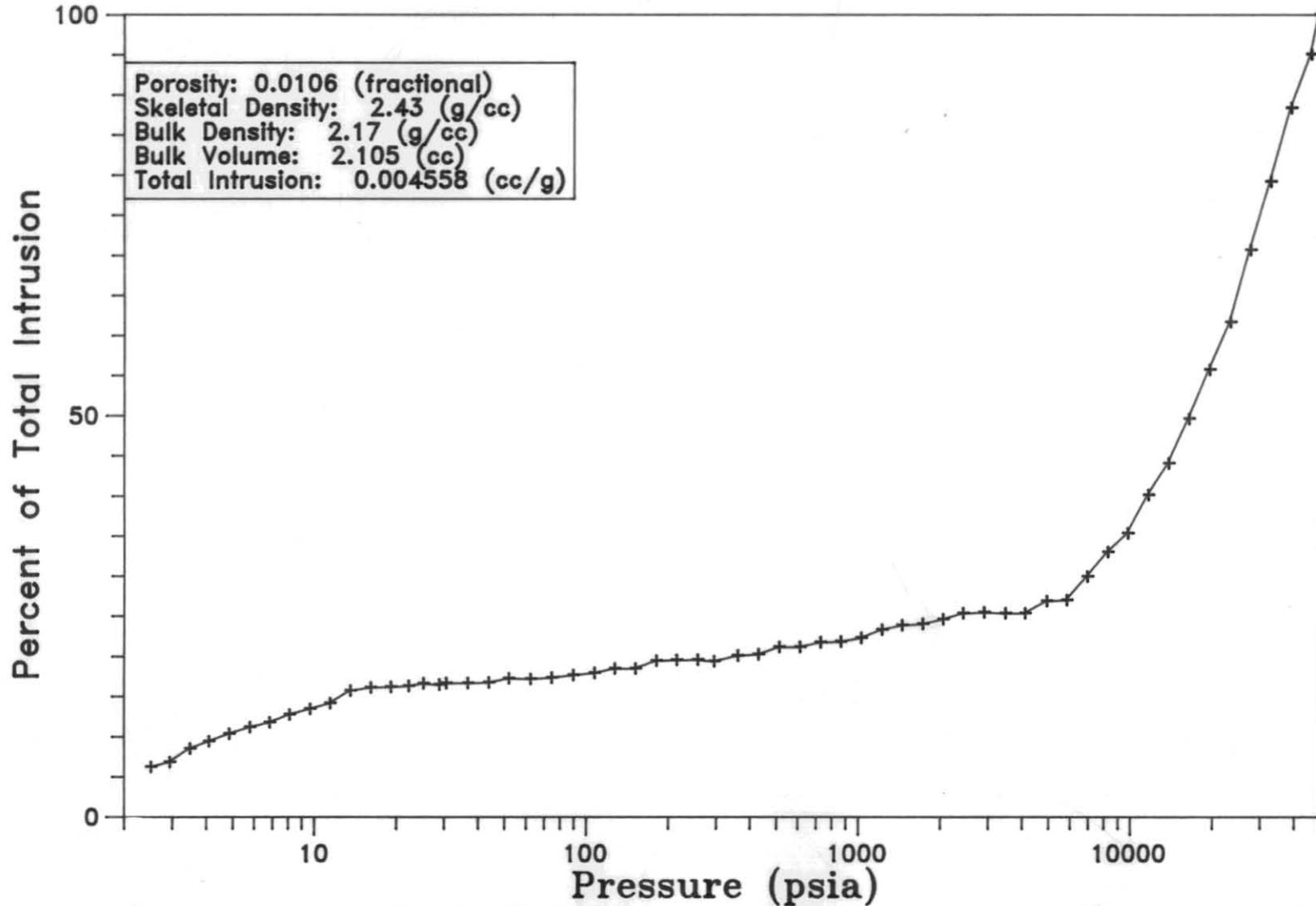
Figure 12

250032

Pore Radius vs Incremental Intrusion
Cormorant No.1   Depth 3818'

Porosity: 0.0106 (fractional)
Skeletal Density: 2.43 (g/cc)
Bulk Density: 2.17 (g/cc)
Bulk Volume: 2.105 (cc)
Total Intrusion: 0.004558 (cc/g)
Breakthrough Diameter 0.060 (microns)

Incremental Intrusion (cc/g)

Pore Diameter (microns)

5 cm

008/105 Bass Basin

Amdel Core Services Pty Limited
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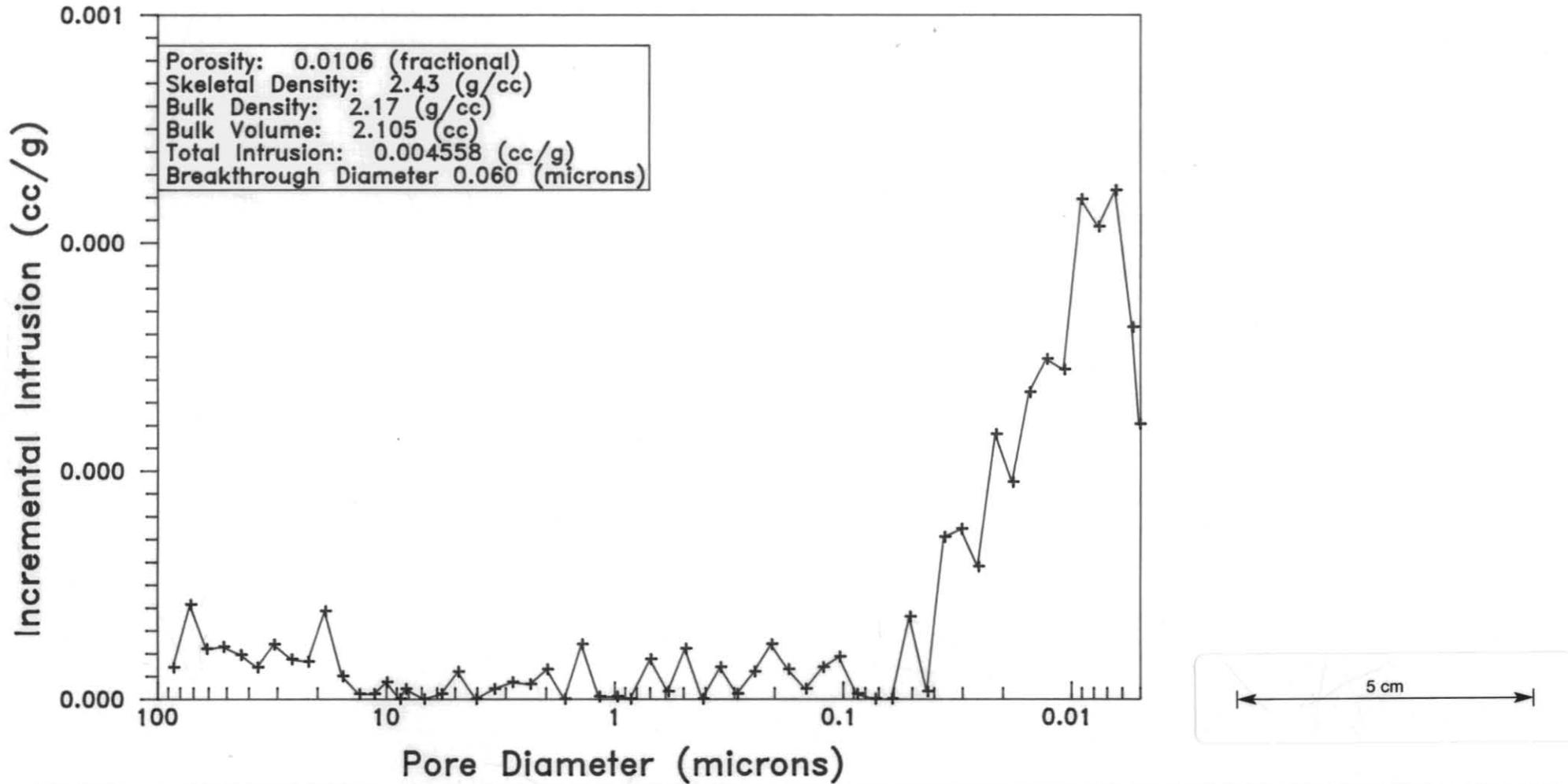
19 August 1991

MERCURY INJECTION DATA

Company	Shell Australia

Sample	Outcrop
Porosity	0.344 (fractional)
Bulk Density	1.61 g/cc
Sample Volume	2.01 cc
Skeletal Density	2.45 g/cc
Total Intrusion	0.18389 cc/g

Table VII

Pressure psia	Cumulative Intrusion (ml)	Cumulative Intrusion (%)	Incremental Intrusion (%)	Pore Diameter (μm)	Incremental Volume (ml/g)
2.49	0.00106	0.177396			
2.88	0.00378	0.632604	0.45521	86.87129	0.000842
3.44	0.00937	1.56812	0.93552	72.72945	0.001731
4.08	0.01294	2.16558	0.59746	61.32091	0.001105
4.82	0.01725	2.88688	0.72130	51.90649	0.001335
5.73	0.02240	3.74876	0.86188	43.66305	0.001595
6.76	0.02975	4.97883	1.23006	37.01025	0.002276
8.03	0.03635	6.08338	1.10455	31.15682	0.002044
9.53	0.04511	7.54941	1.46604	26.25281	0.002713
11.3	0.06249	10.4580	2.90864	22.14064	0.005384
13.44	0.09184	15.3699	4.91189	18.61527	0.009092
15.97	0.15873	26.5644	11.19440	15.66620	0.020721
18.95	0.23319	39.0257	12.46130	13.20260	0.023066
21.95	0.28705	48.0394	9.01377	11.39814	0.016684
24.93	0.32261	53.9906	5.95117	10.03567	0.011015
28.51	0.35302	59.0799	5.08928	8.775493	0.009420
30.57	0.36119	60.4472	1.36730	8.184145	0.002530
36.47	0.39384	65.9113	5.46410	6.860140	0.010114
43.74	0.41677	69.7488	3.83746	5.719920	0.007103
52.26	0.43569	72.9152	3.16637	4.787396	0.005861
62.58	0.45043	75.3820	2.46682	3.997911	0.004566
74.74	0.46288	77.4656	2.08358	3.347462	0.003856
88.99	0.47327	79.2044	1.73882	2.811431	0.003218
106.72	0.48242	80.7357	1.53130	2.344352	0.002834
126.56	0.49061	82.1063	1.37064	1.976843	0.002537
150.28	0.49765	83.2845	1.17818	1.664821	0.002180
179.34	0.50465	84.4560	1.17149	1.395055	0.002168
213.08	0.50971	85.3028	0.84682	1.174156	0.001567
253.92	0.51547	86.2668	0.96397	0.985307	0.001784

Table VII (continued)

Pressure psia	Cumulative Intrusion (ml)	Cumulative Intrusion (%)	Incremental Intrusion (%)	Pore Diameter (μm)	Incremental Volume (ml/g)
291.55	0.51926	86.9011	0.634277	0.858135	0.001174
.356.95	0.5255	87.9454	1.044300	0.700908	0.001933
423.99	0.52907	88.5428	0.597459	0.590083	0.001105
504.89	0.53325	89.2424	0.699546	0.495532	0.001294
603.40	0.53677	89.8315	0.589091	0.414632	0.001090
716.76	0.53994	90.3620	0.530517	0.349055	0.000982
853.60	0.54240	90.7737	0.411694	0.293099	0.000762
1015.40	0.54486	91.1854	0.411694	0.246394	0.000762
1205.09	0.54811	91.7293	0.543905	0.207610	0.001006
1431.96	0.55133	92.2682	0.538885	0.174718	0.000997
1703.69	0.55234	92.4372	0.169029	0.146851	0.000312
2024.68	0.55458	92.8121	0.374876	0.123569	0.000693
2397.70	0.55656	93.1434	0.331364	0.104345	0.000613
2866.46	0.56070	93.8363	0.692852	0.087281	0.001282
3431.61	0.56404	94.3953	0.558967	0.072907	0.001034
4041.92	0.56695	94.8823	0.487004	0.061898	0.000901
4874.23	0.56867	95.1701	0.287851	0.051328	0.000532
5790.25	0.57051	95.4781	0.307934	0.043208	0.000570
6868.91	0.57280	95.8613	0.383244	0.036423	0.000709
8146.08	0.57544	96.3031	0.441818	0.030712	0.000817
9681.56	0.57729	96.6127	0.309607	0.025841	0.000573
11501.7	0.58081	97.2018	0.589091	0.021752	0.001090
13714.0	0.58376	97.6955	0.493699	0.018243	0.000913
16237.2	0.58662	98.1741	0.478637	0.015408	0.000885
19351.2	0.58922	98.6093	0.435124	0.012928	0.000805
23056.0	0.59216	99.1013	0.492025	0.010851	0.000910
27406.5	0.59467	99.5214	0.420062	0.009128	0.000777

Figure 13

Cumulative Intrusion vs Pressure
Outcrop

250035

Porosity: 0.344 (fractional)
Skeletal Density: 2.45 (g/cc)
Bulk Density: 1.61 (g/cc)
Bulk Volume: 2.01 (cc)
Total Intrusion: 0.183890 (cc/g)
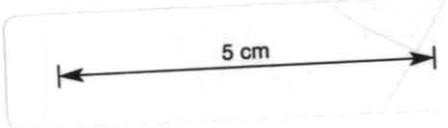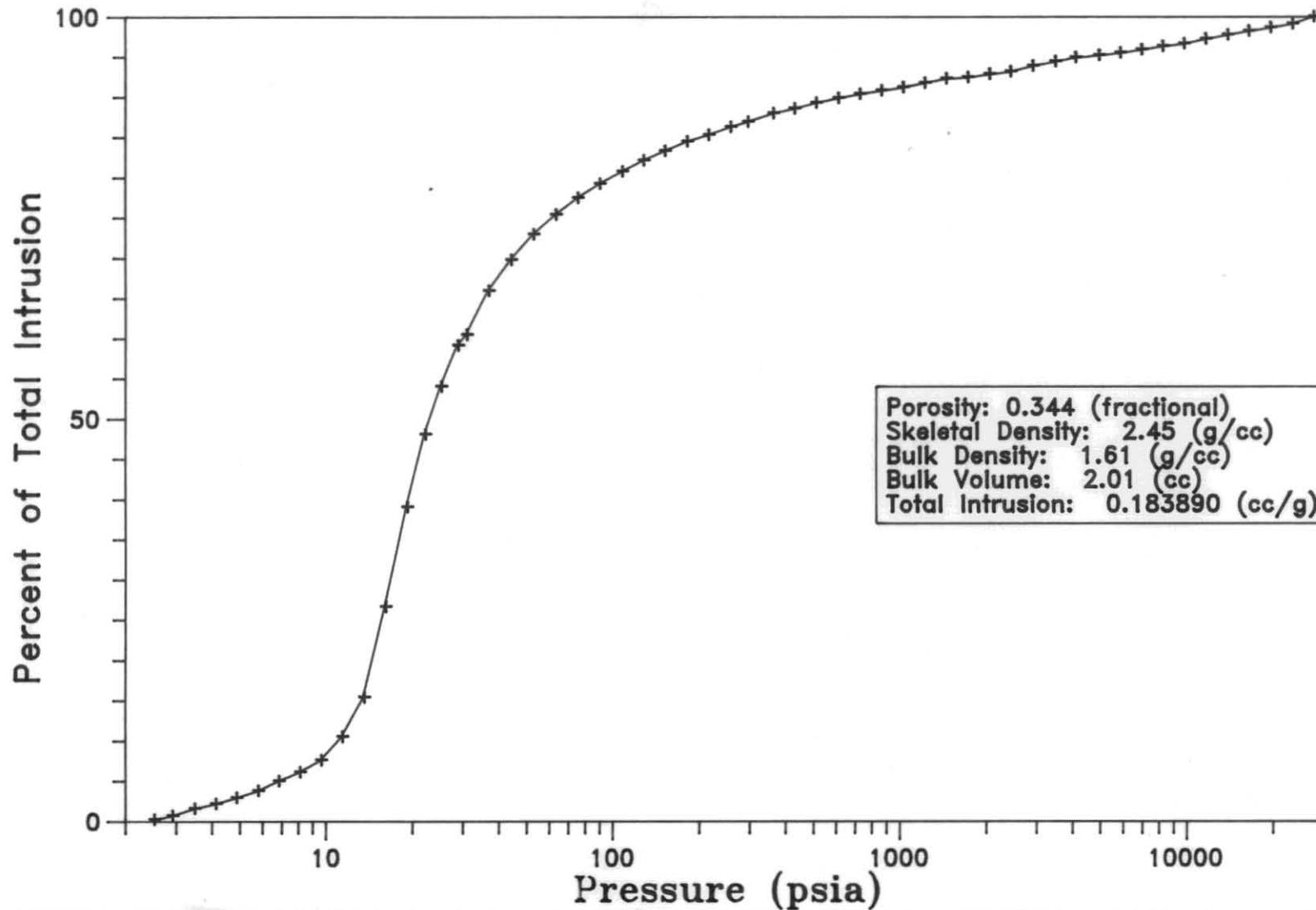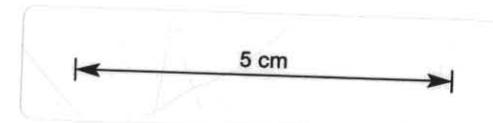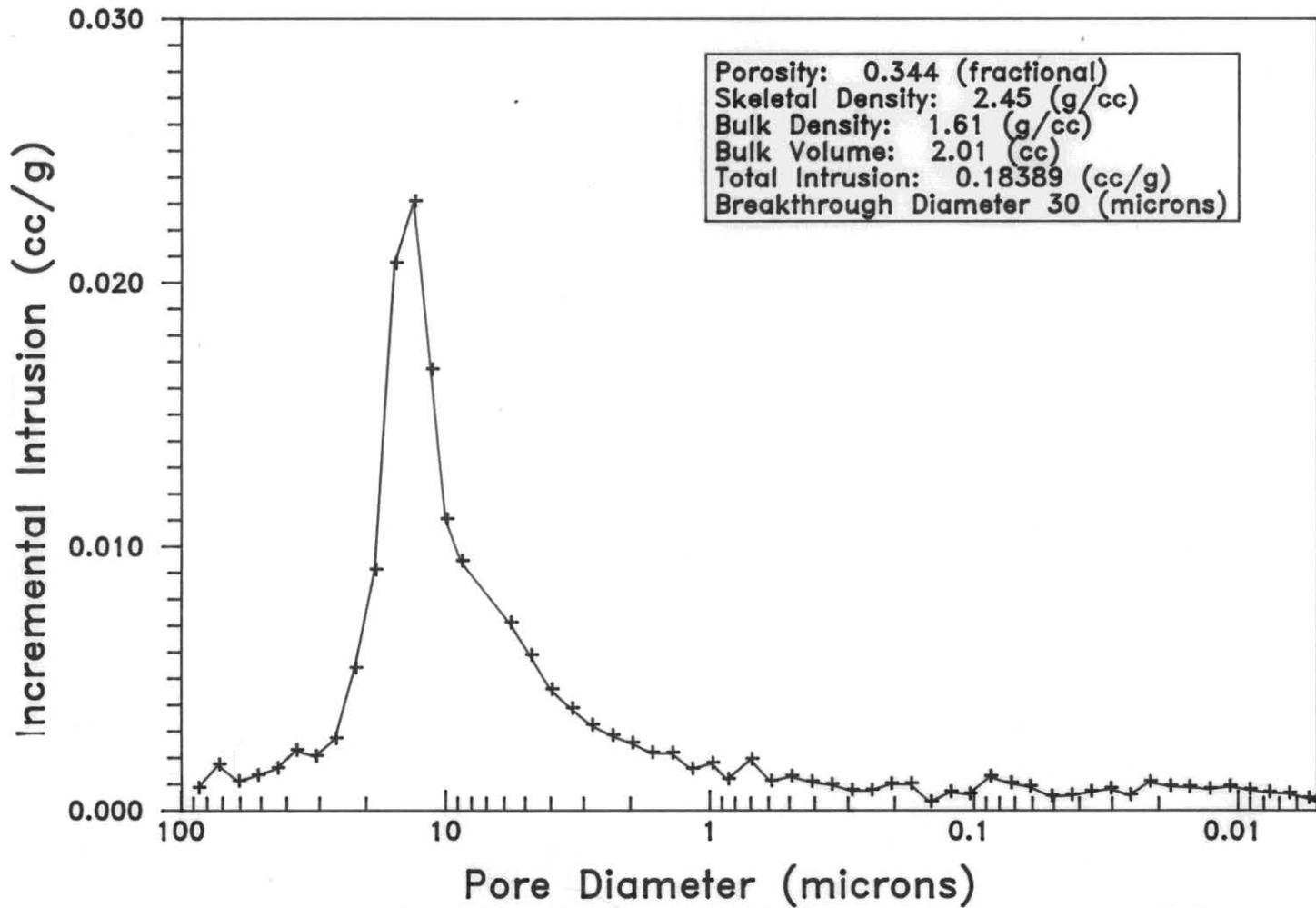
008/105 Bass Basin

5 cm

Amdel Core Services Pty Limited
(Incorporated in South Australia)

Figure 14

250036

Pore Radius vs Incremental Intrusion
Outcrop

Porosity: 0.344 (fractional)
Skeletal Density: 2.45 (g/cc)
Bulk Density: 1.61 (g/cc)
Bulk Volume: 2.01 (cc)
Total Intrusion: 0.18389 (cc/g)
Breakthrough Diameter 30 (microns)

008/105 Bass Basin

Amdel Core Services Pty Limited
(Incorporated in South Australia)

MERCURY INJECTION DATA - SUMMARY

Company   Shell Australia

Table VIII

Sample	Depth, feet	Mercury Porosity, percent	Median Pore Diameter, microns	Mercury Breakthrough Pressure (psia)	Approximate Equivalent Pressure (MPD) (psia)
Bass 2	3808	13.3	0.1015	86.3	2477
Bass 2	3819	15.7	0.1837	48.1	1370
Bass 3	5027	11.9	0.0645	1250	3896
Cormorant 1	3800	18.4	0.1294	481	1944
Cormorant 1	3818	1.06	0.0152	4170	16486
Cormorant 1	4272	11.7	0.0484	1920	5208
Outcrop	-	34.4	10.9	8.3	22.9