

OIL and GAS DIVISION

DEPT. NAT. RES & ENV



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HYDROCARBON REPORT

COBIA - 1

ESSO PRODUCTION RESEARCH COMPANY

HYDROCARBON REPORT - SUBSURFACE OIL
COBIA NO. 1 WELL, FIT NO. 2
ESSO AUSTRALIA LTD.

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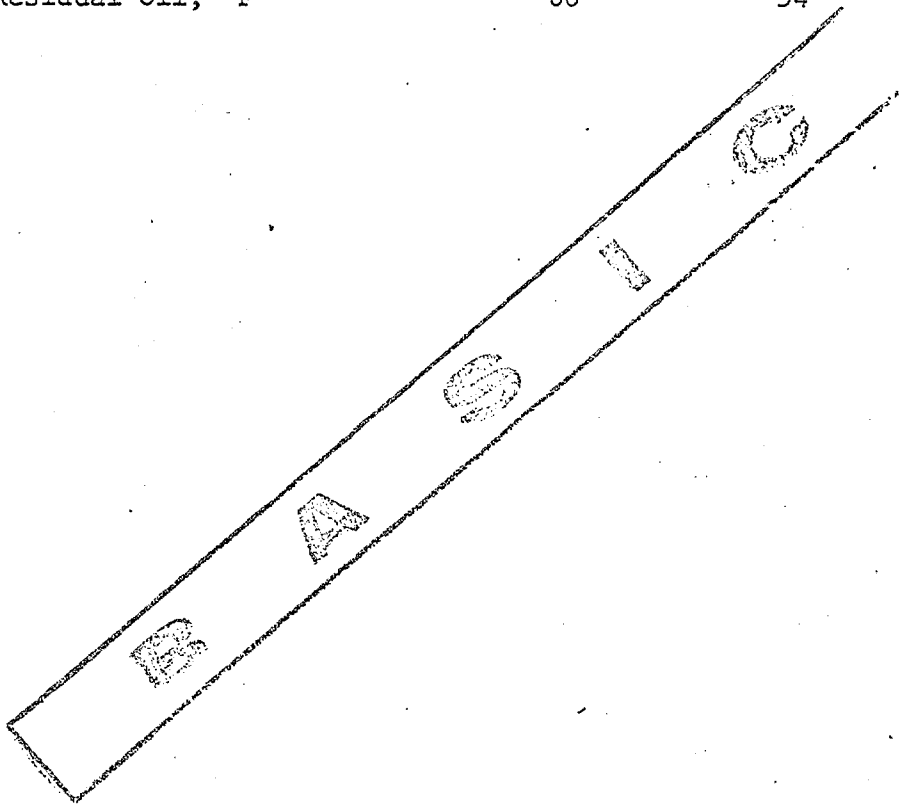
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Comparisons between Crudes from Cobia,
Halibut, and Mackerel Fields

	<u>Cobia-1</u>	<u>Halibut A-1*</u>	<u>Mackerel 3**</u>
Bubble Point at Reservoir Temperature, °F	225	237	335
<u>Atmospheric Flash Liberation Results</u>			
Gas-Oil Ratio, cu ft/bbl	76	76	197
°API at 60°F of Residual Oil	44.7	43.3	47.0
Flash Gas Specific Gravity (air = 1)			
VR/Vs	0.8672	0.8751	0.8059
Pour Point of Residual Oil, °F	60	54	65

*EPR.69-PS.93
**EPR88-PS72



COBIA NO. 1 SUBSURFACE OIL SAMPLE

Source: Cobia No. 1 Well, FIT No. 2, Esso Australia Ltd.

Date Taken: August 25, 1972

Sample Data:

Sample was taken August 25, 1972, in a Schlumberger segregator cylinder FIT subsurface tool, and 1900 cc's were transferred to shipping cylinder No. S-5231 at 180°F and 2600-4400 psig.

Reservoir Data:

Depth, subsea
Pressure, psig
Temperature, °F

7864 (7896 M.D.)
3412 → 2396.9 M.S.
220

Saturation Pressure of Sample:

225 psig at 220°F
108 psig at 60°F

Properties of Sample:

Pressure-Volume Relations
Flash and Differential Liberation Results
Comparison of Experimental and Computed Flash
Liberation Results
Hydrocarbon Analysis, Cloud Point, Pour Point,
and Sulfur Content
Viscosity of Reservoir Oil at 220°F
Viscosity of Reservoir Oil at 60°F
Density of Reservoir Oil at Various Temperatures
and Pressures

Table I
Table II
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TABLE I

Pressure-Volume Relations of Subsurface Oil Sample

Source: Cobia No. 1 Well, FIT No. 2, Esso Australia Ltd.

Date Taken: August 25, 1972

Temperature: 220°F

<u>Pressure, psig</u>	<u>Relative Volume, V/V_{bp}</u>	<u>*Y = $\frac{P_s - P}{P(\frac{V_t}{V_{bp}} - 1)}$</u>
3500	0.9662	
3075	0.9700	
2750	0.9727	
2330	0.9764	
1895	0.9801	
1500	0.9840	
1110	0.9879	
835	0.9909	
650	0.9929	
565	0.9947	
526	0.9953	
450	0.9968	
350	0.9979	
P _s = 225	1.0000	
207	1.0430	1.885
198	1.0609	1.838
189	1.0986	1.790
174	1.1577	1.711
162	1.2166	1.643
147	1.3069	1.569
135	1.3984	1.506
119	1.5564	1.422
108	1.6974	1.364
98	1.8573	1.311
84	2.1504	1.238
74	2.4318	1.185
64	2.7987	1.133

Specific Volume at Saturation Pressure = 0.02238 cu ft/lb

*Calculated data for use in correcting subsurface oil sample

P_s = Saturation pressure of sample at 220° F, psia

P = Pressure below saturation pressure, psia

V_t = Two-phase relative volume factor at 220° F and PV_{bp} = Saturated oil relative volume at 220° F and 240 psia (225 psig)

TABLE II

Flash Liberation and Differential Liberation Results
Subsurface Oil Sample

Source: Cobia No. 1 Well, FIT No. 2, Esso Australia Ltd.

Date Taken: August 25, 1972

Properties of Saturated Oil: Temperature, °F 220 Saturation Pressure, psig 225

Gas Liberation and Shrinkage of Oil:
(Flash)

Pressure (p ₁), psig	Temperature, °F	P ₁	Flashed at P ₁ to 0	Gas-Oil Ratio: cu ft at 60° F and 14.7 psia/bbl Residual Oil		Specific Gravity Gas at 60° F (air = 1)	V _R /V _S *
				Flashed from °API at 60° F	Residual Oil Gravity, °API at 60° F		
0	60	-	-	44.6	1.250	0.9715	
0	76	-	-	44.0	1.290	0.8672	

(Differential at 220 ° F)

Properties of Liberated Gas at Gas-Oil Ratio: cu ft at 14.7 psia Residual Oil
Pressure, 220° F and Indicated Pressure, 225 psig, 220 ° F
Compressibility, Z:Viscosity, cp

225							1.0000
200	0.959	0.0115	6	73			0.9941
150	0.961	0.0111	17	67			0.9842
100	0.963	0.0104	31	42			0.9738
75	0.963	0.0096	38	35			0.9677
52	0.968	0.0088	50	23			0.9617
28	0.976	0.0075	65	8			0.9468
0	0.991	0.0052	73	0			0.9410

*V_R = Volume residual oil at 0 psig, 60° F
 V_S = Volume saturated oil at 225 psig, 220° F
 **V = Volume saturated oil at indicated pressure, 220 ° F
 *** = Determined from calculated composition of equilibrium gas

TABLE II-A

Comparison of Experimental and Computed Flash Liberation Results
Subsurface Oil Sample

Source: Cobia No. 1 Well, FIT No. 2, Esso Australia Ltd.

Date Taken: August 25, 1972

Pressure psig	Temperature °F	Gas-Oil Ratio - cu ft/bbl Residual Oil Flashed from P1 to 0		Residual Oil Gravity °API at 60° F		VR/Vs	
		Experimental	Computed	Experimental	Computed	Experimental	Computed
0	60*	60	61	44.6	44.7	0.9715	0.9608
0	75*	76	70	44.0	44.5	0.8672	0.8700

Data Used in Flash Calculations

Subsurface Oil Sample		
Component	Mol %	gal/mol
Hydrogen Sulfide	Nil	
Carbon Dioxide	0.31	9.42
Nitrogen	0.16	
Methane	3.53	
Ethane	1.78	
Propane	5.03	
Iso-Butane	2.82	
N-Butane	5.14	
Iso-Pentane	2.55	
N-Pentane	4.20	
Hexanes	7.91	
Heptanes	8.90	16.11
Octanes	7.75	16.74
Nonanes	5.91	18.86
Heavier Fraction	44.01	20.25
Total	100.00	33.93

NGAA (1957)
Convergence Pressure: 6568

Unadjusted Flash Data

Molecular weight of heavier fraction 244
Density of heavier fraction, gm/cc at 60° F 0.8532
Specific volume of reservoir fluid at 225 psig bubble point and 220° F, cu ft/lb 0.02238
Mols per barrel 1.639

*The density of the C10+ fraction was increased 1% for this comparison.

Alpha 1 = 1.0077
Alpha 2 = 0.9634

TABLE III

Hydrocarbon Analysis of Subsurface Oil Sample

Source: Cobia No. 1 Well, FIT No. 2, Esso Australia Ltd.

Date Taken: August 25, 1972

<u>Component</u>	<u>Weight Percent</u>	<u>Density, gm/cc at 60°F</u>	<u>Molecular Weight</u>
Hydrogen Sulfide	Nil		
Carbon Dioxide	0.09		
Nitrogen	0.03		
Methane	0.37		
Ethane	0.35		
Propane	1.45		
Iso-Butane	1.07		
N-Butane	1.95		
Iso-Pentane	1.20		
N-Pentane	1.98		
Hexanes	4.70	0.6767	91
Heptanes	5.87	0.7231	101
Octanes	5.82	0.7306	115
Nonanes	4.98	0.7632	129
Heavier Fraction	70.21	0.8532	244
Total	100.00		
Pentane-Free Fraction		0.8191	188

Ambient Flash Residual Crude Properties

Cloud Point	70°F
Pour Point	60°F
Sulfur Content	0.26 Wt. %

TABLE IV

Viscosity of Reservoir Oil at 220° F

Source: Cobia No. 1 Well, FIT No. 2, Esso Australia Ltd.

Date Taken: August 25, 1972

<u>Pressure, psig</u>	<u>Viscosity, cp</u>	<u>Density, gm/cc</u>
3500	0.83	0.7405
3000	0.78	0.7372
2500	0.74	0.7340
2000	0.70	0.7307
1500	0.67	0.7271
1000	0.64	0.7234
500	0.61	0.7185
300	0.60	0.7164
P _s = 225	0.60	0.7155
200	0.61	0.7188
100	0.69	0.7306
0	0.85	0.7453

TABLE IV-A

Viscosity of Reservoir Oil at 60 ° F

Source: Cobia No. 1 Well, FIT No. 2, Esso Australia Ltd.

Date Taken: August 25, 1972

<u>Pressure, psig</u>	<u>Viscosity, cp</u>	<u>Density, gm/cc</u>
3500	4.02	0.8112
3000	3.92	0.8093
2500	3.82	0.8067
2000	3.71	0.8046
1500	3.61	0.8019
1000	3.50	0.7994
500	3.39	0.7968
P _s = 108	3.30	0.7946
75	3.33	0.7968
50	3.38	0.7987
0	3.50	0.8027

TABLE V

Density of Reservoir Oil at Various Temperatures and Pressures

Source: Cobia No. 1 Well, FIT No. 2, Esso Australia Ltd.

Date Taken: August 25, 1972

Pressure, psig	60°F	140°F	180°F	220°F
	gm/cc			
3500	0.8112	0.7756	0.7582	0.7405
3000	0.8093	0.7735	0.7551	0.7372
2500	0.8067	0.7709	0.7522	0.7340
2000	0.8046	0.7680	0.7492	0.7307
1500	0.8019	0.7646	0.7461	0.7271
1000	0.7994	0.7615	0.7424	0.7234
600	0.7973	0.7590	0.7391	0.7195
400	0.7960	0.7579	0.7372	0.7172
225	-	-	-	0.7155 (Ps)
200	0.7951	0.7564	0.7350	0.7188
195	-	-	0.7349 (Ps)	-
167	-	0.7518 (Ps)	-	-
108	0.7946 (Ps)	-	-	-
100	0.7952	0.7597	0.7453	0.7306
50	0.7987	0.7656	0.7508	0.7420
0	0.8027	0.7715	0.7563	0.7453