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BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD

1979/10

PARTIAL ASSESSMENT OF THE RECOVERABLE HYDROCARBON POTENTIAL OF THE VULCAN SUB-BASIN, BONAPARTE GULF BASIN, NORTHERN TERRITORY

by

D.J. Forman and W.J. McAvoy

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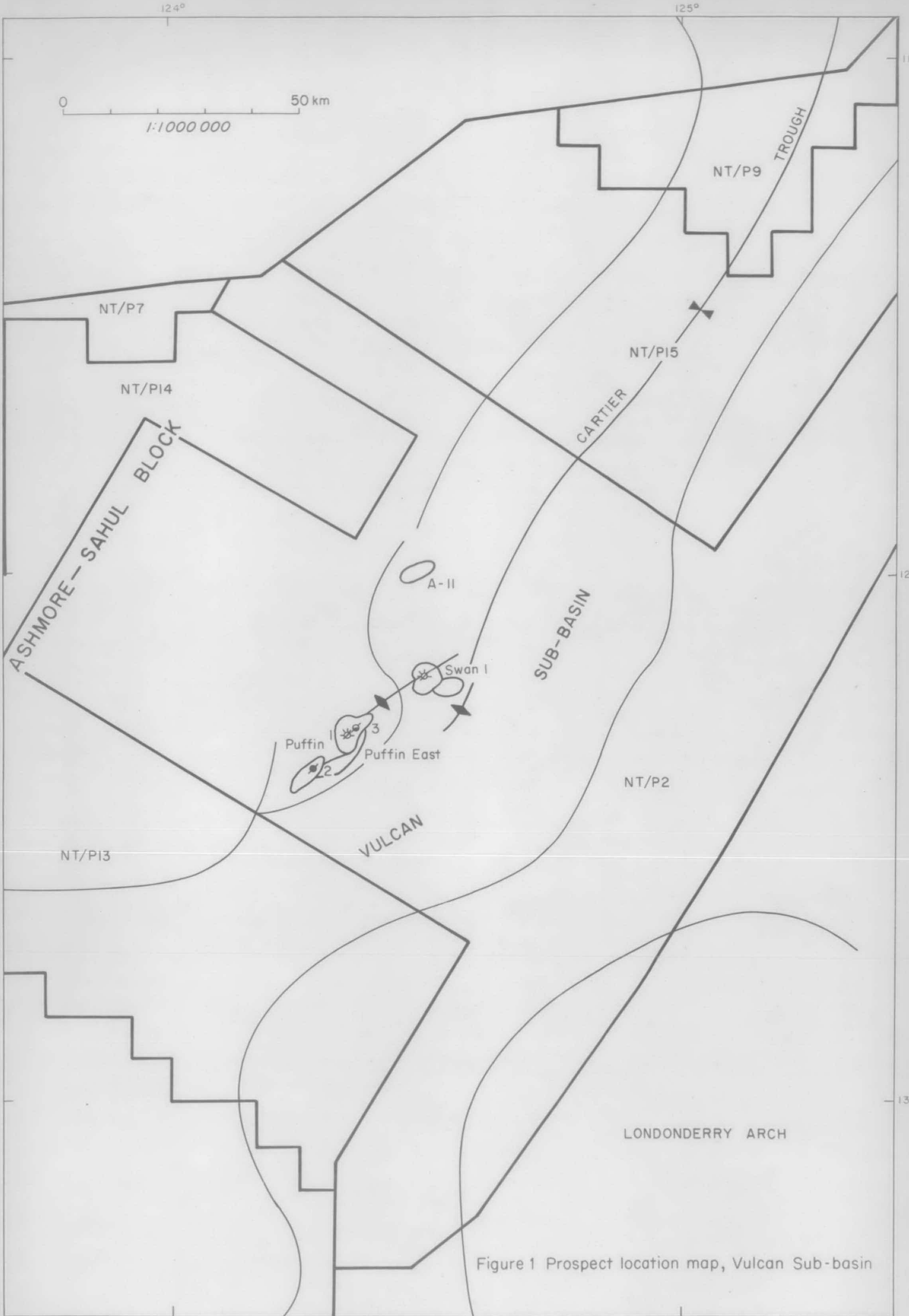

Figure 1 Prospect location map, Vulcan Sub-basin

SUMMARY

The recoverable petroleum resources of the Upper Cretaceous play in the Vulcan Sub-basin of the Bonaparte Gulf Basin in the Northern Territory have been assessed. There is insufficient information for a reliable assessment of the measured plus indicated resources of the Puffin fields, but single value calculations suggest they could contain up to 4.6 million cubic metres (29 million barrels) of recoverable oil. The Swan field contains negligible measured plus indicated resources of about 260 million cubic metres (9.9 billion cubic feet) of recoverable gas.

Hypothetical resources exist in Swan compartments 2 and 3, in Puffin East prospect, and in A-11 prospect. These prospects have been assessed by the prospect method, using a Monte Carlo simulation computer program called Simulat (Riesz, 1978), and the results are summarised below.

RECOVERABLE HYPOTHETICAL RESOURCES (m^3)

	mean estimate (unrisked)		existence risk		risked mean	
	oil$\times10^6$(or)	gas$\times10^9$	oil	gas	oil$\times10^6$(and)	gas$\times10^9$
Swan compartments 2 and 3	14	15	.25	.5	3.4	7.4
Puffin East	1.9	2.5	.20	.10	.39	.25
A-11	5.4	6.9	.13	.13	.7	.9

If all propects are drilled there is a 50 percent chance of finding some oil and a 60 percent chance of finding some gas. Addition of the hypothetical resources yields a risked mean estimate for these prospects of 4.5 million cubic metres (28.5 million barrels) of recoverable oil and 8550 million cubic metres (302 billion cubic feet) of recoverable gas.

Since completion of this study, new seismic data have been obtained (ARCO, 1977) and the horizon maps on which this assessment is based have been updated. Also, East Swan No. 1, has tested Swan compartment 3 negatively. It is recommended, therefore, that the play should be re-assessed using these new data.

INTRODUCTION

The recoverable hydrocarbon potential of the Upper Cretaceous play in the Vulcan Sub-basin has been rapidly assessed, as part of a continuing program of quantitative appraisal of the hydrocarbon potential of Australia. All relevant information available to BMR (from BOC and ARCO) has been used to arrive at the hypotheses and conclusions presented in the report. Location of permits, exploration history, regional geology and geophysics, stratigraphy, and structure have been described by McAvoy & Temple (1976).

PLAY ASSESSMENT

Plays

(1) Fold, fault, and stratigraphic traps containing Upper Cretaceous marine sandstones, sealed by Upper Cretaceous and Tertiary claystone and marl. Sourced either by Upper Cretaceous or by Upper Jurassic claystone.

(2) Structural and stratigraphic traps containing Upper Jurassic sandstones. Sourced by Upper Jurassic claystones and sealed by Upper Jurassic and/or Cretaceous claystone.

(3) Structural traps containing Triassic sandstones. Sourced by Upper Jurassic claystone and sealed by Upper Jurassic and/or Cretaceous claystone.

(4) Structural traps containing Permian sediments of unknown type.

Only the Upper Cretaceous play has been assessed in this study.

Generation

Significant hydrocarbon shows in all the Puffin wells and at Swan No. 1 prove that both oil and gas have been generated in the area.

Organic matter

Upper Cretaceous sediments in Puffin No. 1 and Swan No. 1 average about 0.5 percent total organic carbon, but a few samples range up to one percent. Sapropelic material is dominant in two sections, 60 to 90 metres thick, in Swan No. 1 and in one section 60 to 90 m thick in Puffin No. 1. Based on these analyses by ARCO, source rock quality is marginal, possibly ranging up to fair.

Upper Jurassic sediments penetrated at Swan No. 1 average about 1.5 percent total organic carbon and are therefore rated as good to excellent potential source rocks.

The small proportion of Triassic sediment that has been drilled averages 0.2 to 0.3 percent total organic carbon and therefore has negligible source potential.

Permian sediments have not been drilled in the area.

Maturation

On the basis of clay mineralogy determinations, ARCO estimates that the top of the montmorillonite dehydration zone lies at 2012 m in the Upper Cretaceous at Puffin No. 1, where present-day temperatures are 77°C. The base of the zone is estimated at 2377 m at the Upper Cretaceous/Triassic unconformity, where present-day temperatures are 87°C. In Puffin No. 2, there is a sharp decrease in montmorillonite percentage from 100 percent at 2000 m in the Cretaceous to 10 percent at 2560 m in the Triassic (ARCO, pers. comm.).

At Swan No. 1, the top of the dehydration zone was encountered at 3018 m depth in Upper Jurassic sediments, where the present-day temperature is 96°C. The base of the dehydration zone occurs beneath total depth at 3284 m, where the present-day temperature is 102°C.

If the dehydration zone has been correctly identified at the Puffin structure, then palaeotemperatures may have been about 20°C higher than present-day temperatures.

Conclusions

Total organic carbon content of the Upper Cretaceous sediments is low, and present-day and palaeotemperature may have been marginal for petroleum generation. It is likely, therefore, that the Upper Jurassic claystones are the major source of the oil in the Puffin structure, and that the oil has migrated into the Upper Cretaceous sediments via Jurassic and Triassic sediments and permeable faults.

Time of migration

ARCO believe that the Puffin area has a complex maturation history. Thick Triassic deltaic sediments were partly matured and subsequently uplifted and eroded during the Jurassic, breaching shallow Triassic reservoirs. Data from Swan No. 1 indicate that Upper Jurassic sediments were subsequently deposited, but were eroded from upthrown blocks during the Neocomian. Severe diastrophism, possibly associated with complete separation of a postulated western landmass from Australia, occurred in the Cenomanian.

Upper Cretaceous sediments, over 300 m thick, were deposited, and then faulted and eroded before transgression and burial beneath Tertiary sediments. The Upper Jurassic source rocks and possibly the Upper Cretaceous sediments probably first reached maturity in the Tertiary, and migration occurred as a consequence of clay mineral dehydration. Oil may have been trapped in Upper Cretaceous reservoirs either stratigraphically below the Tertiary unconformity near Puffin and in sand pinchouts or structurally in fold and fault traps. Any petroleum that was generated in the good to excellent Jurassic source rocks could have migrated into the Cretaceous reservoirs at Puffin via the Jurassic and Triassic sequence and permeable channels along the complex late Cretaceous faults to the immediate southeast of the structure.

Reservoir and seal (Upper Cretaceous)

Upper Cretaceous sandstones have been penetrated in a number of wells in the Vulcan Sub-basin and Ashmore-Sahul Block of the Bonaparte Gulf Basin and in the Browse Basin to the south. The net thickness of sandstone drilled and the estimated presence or absence of overlying seal (Cretaceous or Tertiary) are listed below.

Upper Cretaceous sandstone

Well	Sandstone thickness (m)	Seal
Brown Gannet No. 1	0	Present
Swan No. 1	21.3	Present
Puffin No. 3	171	Present
Puffin No. 1	128	Present
Puffin No. 2	238	Present
Prion No. 1	146	Present
Skua No. 1	204	?Absent
Heywood No. 1	265	Absent
Londonderry No. 1	138	Absent
Prudhoe No. 1	295	Absent
Rob Roy No. 1	94	?

This distribution suggests a northerly trending belt of sandstone on the west side of the Londonderry Arch. Age equivalent limestone and shale occur to the north and northwest of this sandstone belt, suggesting a provenance to the south or east. As only sealed sandstone is prospective, the Upper Cretaceous play is resticted to the north of the belt and may not extend far south of Prion No. 1, Puffin No. 1, and Swan No. 1*.

Absence of seal to the south also limits the possibility of extensive migration from south to north. The sandstone to the south (i.e. at Skua No. 1) is mainly in one continuous thick body, raising the possibility that hydrocarbons could migrate from this area along the top of the sandstone body into the topmost of individual sandstones farther north (this is one of several possible explanations for the absence of significant hydrocarbons from all except the upper sandstone at the two Puffin fields).

Helby and Taylor have made micropalaeontological correlations of the sandstones in the northern area for ARCO. The sandstones are mainly of Campanian to late Maestrichtian age. The studies show that the lithological correlation of individual sand intervals may be impossible, and they may be sand lenses, not connected from well to well.

Structural notes

We suggest that the structural pattern of the Upper Cretaceous sediments in the Bonaparte Gulf Basin may be represented by a strain ellipsoid with an axis of maximum extension trending northwest and an axis of maximum shortening trending northeast. A strain ellipsoid with the same orientation may be used to represent the Rankin Trend structures.

The Prion and Puffin structures are northeasterly trending faulted anticlines, flanked by parallel trending synclines developed in the Cretaceous sediments. They overlie horst and graben developed in underlying Triassic and Jurassic sediments, and appear to be of tensional origin. The same northeast trend is preserved in the Vulcan Sub-basin and bounding faults, in part of the Malita Graben, and in numerous faults in the region.

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* The play is now known to extend into the Browse Basin.

The Prion and Puffin structures and their flanking synclines terminate to the north, possibly against a strike slip fault (discontinuous at base Upper Cretaceous level) that trends slightly north of east. This fault may continue west near the southern margin of the Ashmore-Sahul Block. To the east it breaks up into a series of en-echelon northwest-trending tensional faults in the area between the Vulcan Sub-basin and Browse Basin and reappears farther east. Together with a series of tensional faults, it may form the southern margin of the Malita Graben.

Another series of easterly trending faults, that may have had strike slip movements, cross the A11 structure farther north.

The A11 structure and the Swan structure are both northwesterly trending folds flanking the postulated strike slip faults. These are strongly developed folds for which a tensional origin (other than salt dome) appears most unlikely and, therefore, it is suggested that they may be compressional in origin. If so, analysis of the total pattern of folds and faults suggests that the strike slip faults are left lateral and divergent in the Malita Graben, and possibly convergent near the Swan and A11 structures.

Regional domes with a northwesterly trend, such as Kelp and its flanking synclines, may be of partly compressional origin.

Tensional faults on the southeastern margin of the Cartier Trough may terminate to the northeast against another system of strike slip faults.

ASSESSMENT OF IDENTIFIED RESOURCES
(UPPER CRETACEOUS PLAY)

Adjustment of hydrocarbon/water contact for use on horizon 2 map

Two-way time contour maps of horizon 2 (near base of Upper Cretaceous) were used in the assessment. Hydrocarbon water contacts at Puffin and Swan fields were plotted on the maps by adding a time correction to horizon 2 time equal to the time interval between the top of the reservoir and the hydrocarbon water contact as follows -

Puffin No. 1 intersected horizon 2 at 2348 m below rotary table, corresponding to a two-way time of 1.587 seconds below sea level, interpolated from the horizon 2 map. The two-way time difference between the top of the pay (2040 m) and the oil/water contact (2041 m) was measured as .001 seconds on the integrated sonic log. The adjusted oil/water contact is at 1.588 seconds, and this value was used for resource estimates in the Puffin No. 1 and Puffin No. 3 area.

Puffin No. 2 intersected horizon 2 at 2449 m, corresponding to a two-way time of 1.580 seconds, interpolated from the horizon 2 map. The two-way time difference between the top of the pay (2003 m) and the oil/water contact (assumed at base of pay at 2008 m) was measured as .003 seconds on the integrated sonic log. The adjusted oil/water contact is at 1.583 seconds, and this value was used for resource estimates.

Puffin No. 3 intersected horizon 2 at 2395 m, corresponding to a two-way time of 1.588 seconds, interpolated from the horizon 2 map. The two-way time difference between the top of the pay (2073 m) and the oil/water contact (2076 m) was measured as .001 seconds on the integrated sonic log. The adjusted oil/water contact is at 1.589 seconds.

Swan No. 1 intersected horizon 2 at 2630 m, corresponding to a two-way time of 1.680 seconds, interpolated from the horizon 2 map. The two-way time difference between the top of the pay (2362 m) and the gas/water contact (assumed at base of pay at 2366 m) was measured as 0.002 seconds for the top sand on the integrated sonic log and as minus 0.028 seconds for a lower sand of greater thickness. The adjusted gas/water contacts to represent the upper and lower sands are 1.652 seconds and 1.682 seconds, respectively. Either gas/water contact outlines a field too small to be economic. If, however, the accumulation is to be produced we consider that only the area in which both sands lie above the gas/water contact is of interest and, accordingly, the 1.652 seconds contour was used for resource estimates.

Measured plus indicated resources

Measured plus indicated resources of the field penetrated by Puffin Nos. 1 and 3 lie within the area enclosed by the 1.589 seconds contour on the horizon 2 map, and the measured plus indicated resources of the field penetrated by Puffin No. 2 lie within the area enclosed by the 1.583 seconds contour. Swan No. 1 tested the northwestern end of a northwesterly trending faulted anticline. The faults divide the structure into five compartments: 1a, 1b, 1c, 2, and 3. Swan No. 1 partly tested compartment 1a. Compartment 1a contains indicated resources and compartments 1b and 1c contain inferred resources. A major fault separates compartment 1c from compartments 2 and 3 and, therefore, the resources of compartments 2 and 3 are classified as hypothetical.

Single value calculations only were attempted for these fields (Appendix 1).

Field penetrated by Puffin Nos. 1 and 3

Net pay rock volume: Net pay rock volume was determined by planimetering the 1.589 seconds and higher contours over the field on the horizon 2 map. Area of contour on top of pay was plotted versus depth of contour. Area on base of pay versus depth of contour was plotted by employing a pay thickness of 32.9 m. The graphed area lying between top and base of pay was planimetered to determine the net pay rock volume of 166.6 x 10^6 m^3.

Porosity: Porosity values determined by Arco varied from 16 percent to 32 percent. A single value of 27 percent was selected.

Water saturation: Water saturation values in the range of 50 to 60 percent were obtained by log analysis. However, proximity to the oil/water contact suggests that a more reasonable value for water saturation in the reservoir overall is about 35 percent.

Recovery factor: A primary oil recovery factor of 17 percent was calculated, assuming a solution gas drive mechanism.

Reservoir temperature: A reservoir temperature of 168°F (628°R) was calculated for Puffin No. 3, using temperatures recorded on the induction log, corrected for lag in equilibrium between mud temperature and formation temperature, using a set of BOC curves.

Reservoir pressure: 3550 p.s.i.g. is the final shut-in pressure measured during formation interval testing.

Gas deviation factor: A gas deviation factor (Z) is required in case gas overlies the oil. A value of 0.93 was derived from a gas analysis for Swan No. 1, and the same figure is used for the Puffin East prospect.

Formation volume factor: A value of 1.05 was derived from Chart 4 API Bulletin D14.

Results: On this basis, the measured and indicated reserves are estimated (Appendix 1) at 4.6 x 10^6 m^3 (29 x 10^6 barrels).

Field penetrated by Puffin No.2

Area of reservoir: A single value, $4.60 \times 10^6 m^2$, was determined by planimetering the 1.583 seconds contour.

Net pay thickness: A net pay of 4.2 m was determined by ARCO.

Net pay rock volume: Derived by multiplication of area of reservoir and net pay thickness: $19.32 \times 10^6 m^3$.

Porosity: Porosity values determined from the compensated neutron density log varied from 18 percent to 32 percent. A single value of 27 percent was used.

Water saturation: ARCO report a calculated range of 9 to 18 percent. A single value of 12 percent was used.

Reservoir temperature: 620°R derived by straight line interpolation of electric log temperatures and corrected using BOC curves.

Reservoir pressure: A final closed in pressure of 2952 p.s.i.g. was recorded during drill stem testing.

Recovery factor: An oil recovery factor of 17 percent was assumed (as calculated for Puffin Nos. 1, 3 field).

A gas recovery factor of 66 percent was calculated using the formula:

$$R = 1 - \frac{\text{abandonment pressure}}{\text{initial pressure}}$$

$$= 1 - \frac{1014.7}{2967}$$

Formation volume factor: The value of 1.9 determined for Puffin No. 1 was adopted.

Results: On this basis, the measured plus indicated oil reserves are estimated (Appendix 1) at $0.8 \times 10^6 m^3$ (5×10^6 barrels).

Swan field (compartment 1)

Area of reservoir: A single value, $1.13 \times 10^6 m^2$, was determined by planimetering the 1.652 seconds contour on the horizon 2 time contour map.

Net pay thickness: A net pay thickness of 13.7 m was determined from the suite of logs supplied with the well completion report.

Porosity: ARCO report borehole-compensated sonic log derived pososities ranging from 18 to 20 percent, with an average of 19 percent. A single value of 19 percent was used.

Water saturation: We calculated water saturation of 40 percent at 7754 feet and 7760 feet. ARCO report a calculated value of 30 percent. The lower figure of 30 percent was used.

Reservoir pressure: A final shut-in reservoir pressure of 3500 p.s.i.g. was measured during a formation interval test.

Reservoir temperature: 640°R, obtained by straight line interpolation of electric log temperature and subsequently corrected using curves.

Recovery factor: A gas recovery factor of 71 percent was calculated using

$$R = 1 - \frac{1014.7}{3514.7}$$

An oil recovery factor of 17 percent is assumed (as calculated for Puffin No. 3).

Gas deviation factor: 0.93 was calculated using an analysis of gas from the well.

Results: On this basis, the possible recoverable gas resources within Swan compartment 1 (Appendix 1) are very small (about 260 million cubic metres).

ASSESSMENT OF HYPOTHETICAL RESOURCES
(UPPER CRETACEOUS PLAY)

Hypothetical resources may exist in Swan compartments 2 and 3, at Prospect A-11, in a fault trap to the east of Puffin Nos.1 and 3, and in a number of minor closures mapped to the northwest of the Puffin fields. The minor closures northwest of the Puffin fields are individually too small to be economic and their resources are not assessed. Swan compartments 2 and 3 offer the best prospect of containing significant recoverable gas resources. Reservoir parameters for each prospect are summarised in Table 1 and where necessary the basis for their selection is discussed below.

Net pay rock volume: Net pay rock volume of Swan compartments 2 and 3 and of prospect A11 were calculated by combining estimates of area of reservoir with thickness of net pay. Net pay rock volume of the fault trap to the east of Puffin Nos. 1 and 3 (Puffin East prospect) was estimated by combining reservoir volume, determined graphically, with percent net pay derived from sand percentages in the adjacent wells.

Consideration of possible sand distributions within the reservoir sections suggests that both these methods involve probably incorrect assumptions. The first method assumes that all the sandstone occurs at the top of the reservoir. The second assumes that all sandstone is evenly distributed throughout the reservoir. Further study of this problem is recommended so that future studies may take better account of alternative sand distributions.

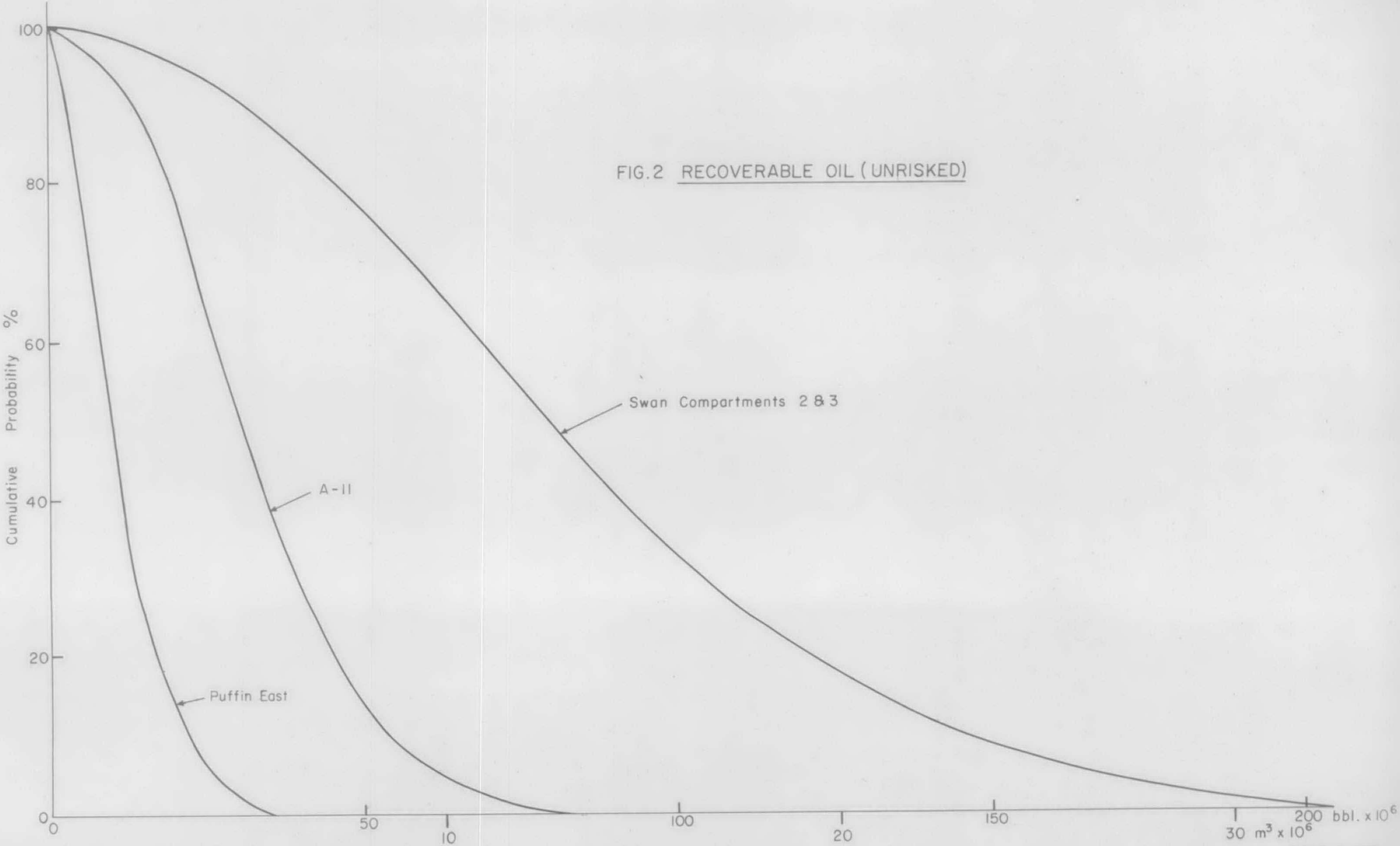
Porosity: Ranges of values were adopted after consideration of log derived porosities measured in nearby wells.

Water saturation: Water saturation and porosity are probably not completely independent variables. Furthermore, water saturation will vary with position relative to the hydrocarbon/water contact. In further studies consideration should be given to the use of hydrocarbon pore volume as a fraction of rock volume, 0 (1-Sw), as a single independent variable. However, the positional problem is difficult to solve with the existing simple computer program.

Reservoir temperature: Reservoir temperatures for Swan and A11 prospects were derived using Swan No. 1 temperature/depth curve. Temperature for Puffin East was derived from the Puffin No. 3 temperature/depth curve.

Reservoir pressure: Reservoir pressures for Swan and A11 prospects are based on the final shut-in pressure at Swan No. 1, corrected for depth differences of potential reservoirs.

FIG. 2 RECOVERABLE OIL (UNRISKED)



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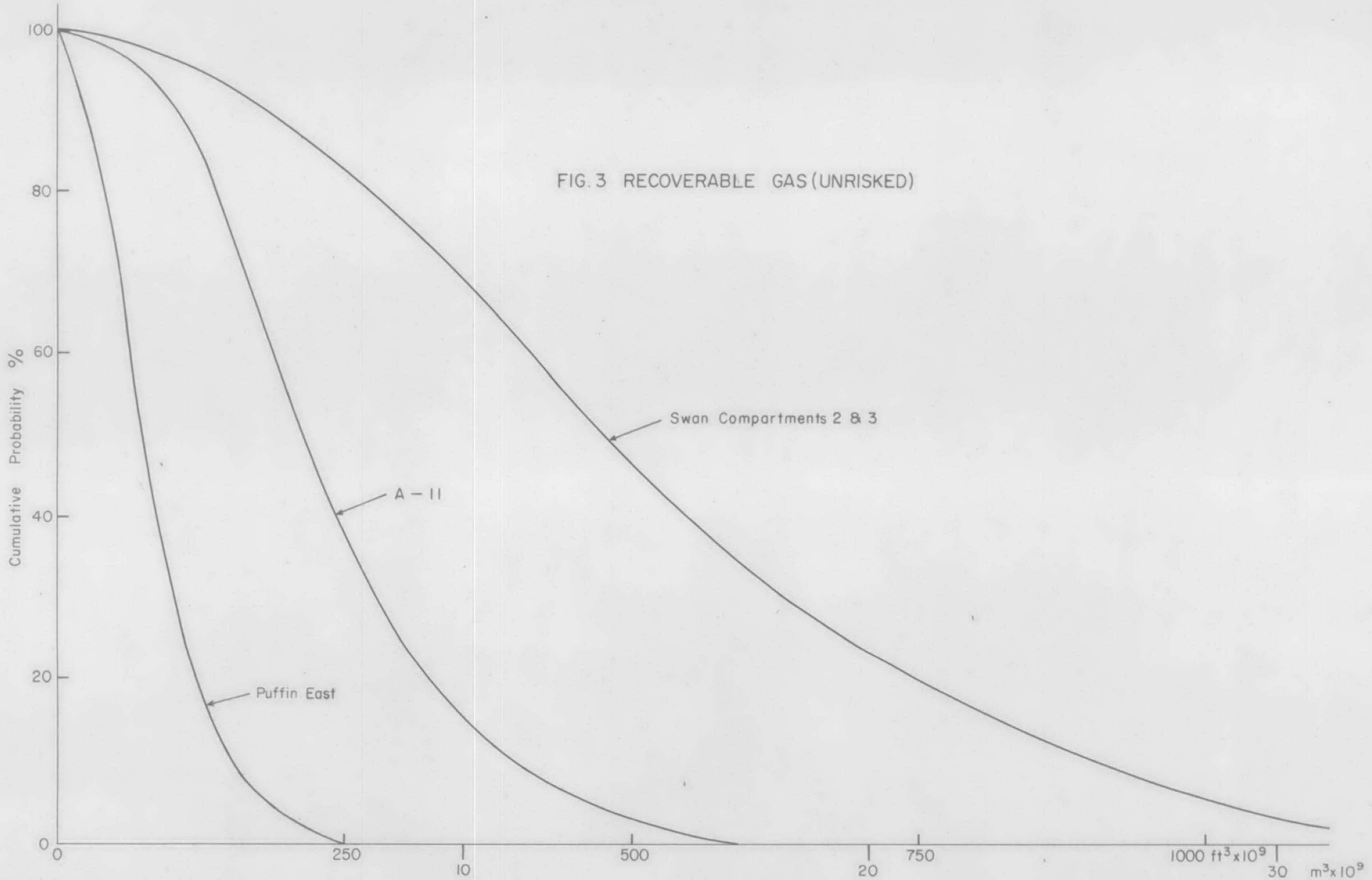

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Recovery factor: An oil recovery factor of 17 percent was assumed as calculated for Puffin 1, 3 field.

A gas recovery factor was calculated for each prospect using the formula:

$$R = 1 - \frac{\text{abandonment pressure}}{\text{initial pressure}}$$

Existence risk: The risks for each critical factor are summarised in Table 2. These risks have been used to calculate the following existence risks for each prospect and for the remaining play potential.

	Existence risk	
	Oil	Gas
Swan compartments 2 & 3	.25	.5
Puffin East	.20	.10
A-11	.13	.13
All prospects combined	.50	.60

Results: The hypothetical recoverable resources of each prospect have been estimated using program Simulat (Riesz, 1978) and are plotted in Figures 2 and 3. The hypothetical resources of all the prospects have also been added using program Simulat and the results are plotted in Figures 4 and 5.

In Swan compartments 2 and 3, the oil existence risk is 0.25, and there is an unrisked mean estimate of 14 million cubic metres (88 million barrels) of recoverable oil. Gas existence risk is 0.5, and there is an unrisked mean estimate of 15 billion cubic metres (530 billion cubic feet) of recoverable gas.

In Puffin East prospect, the oil existence risk is 0.20, and there is an unrisked mean estimate of 1.9 million cubic metres (12 million barrels) of recoverable oil. Gas existence risk is 0.10, and there is an unrisked mean

FIG.4 RISKED OIL UPPER CRETACEOUS PLAY

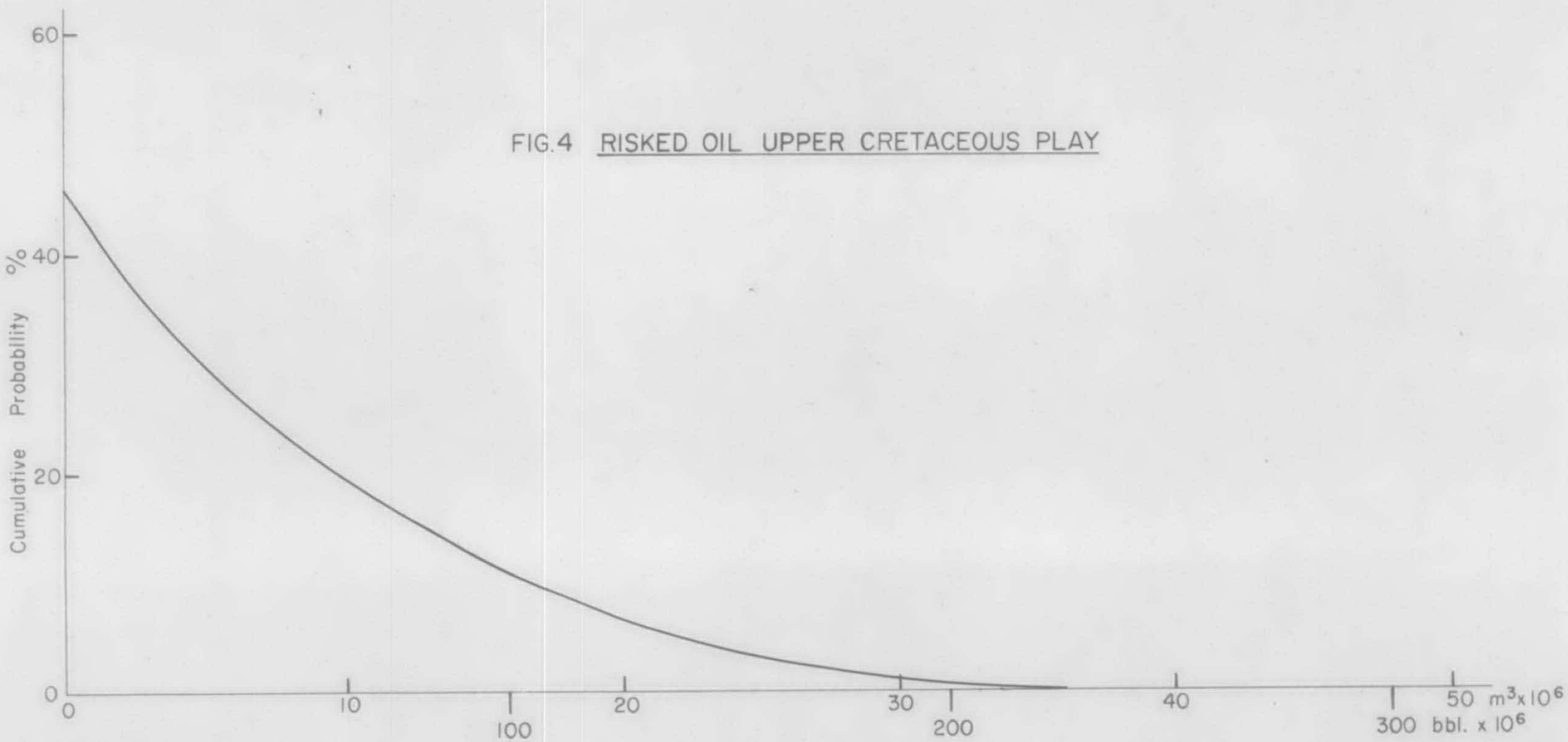

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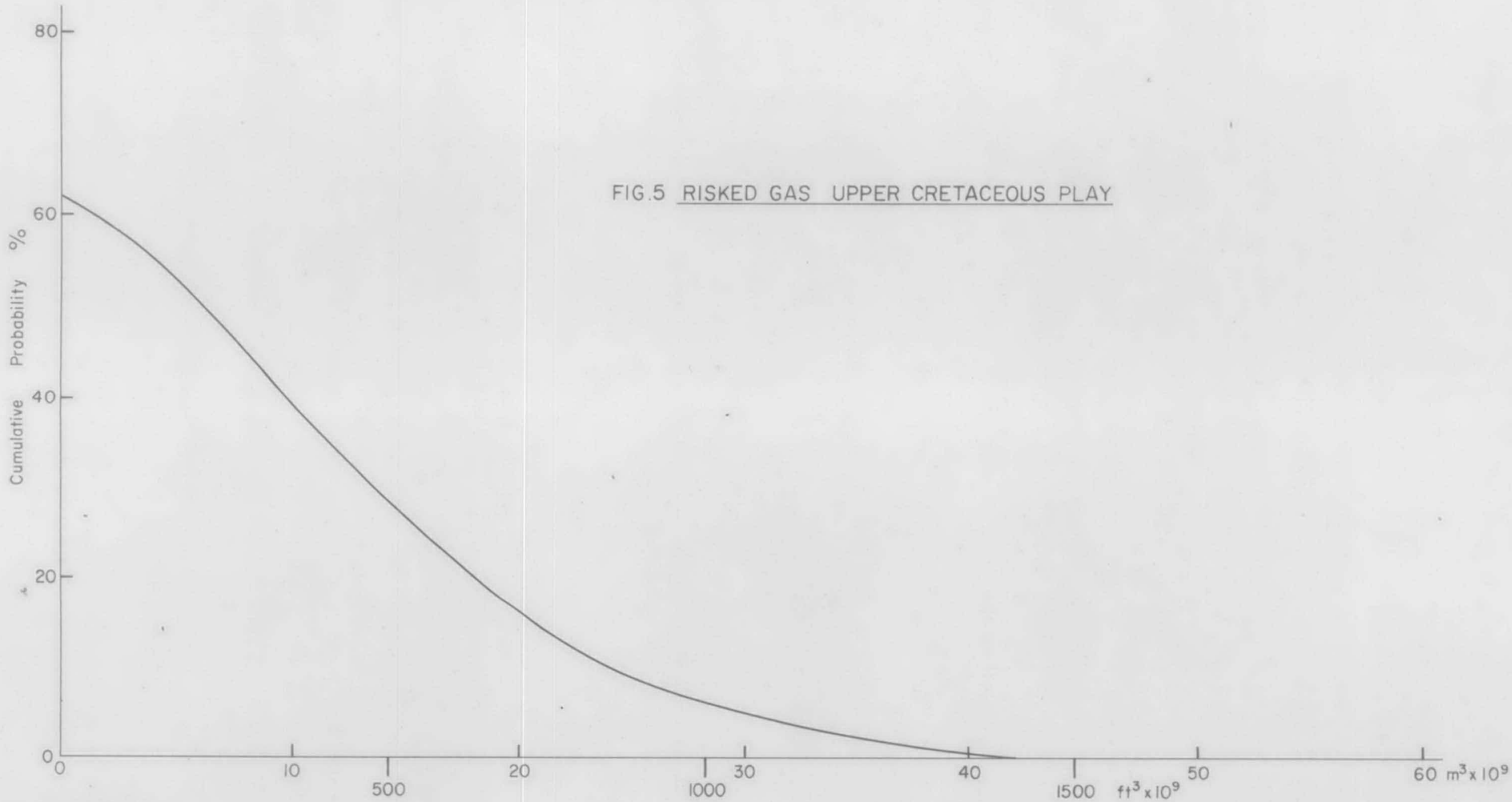
FIG.5 RISKED GAS UPPER CRETACEOUS PLAY



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estimate of 2.5 billion cubic metres (88 billion cubic feet) of recoverable gas.

In A-11 prospect the oil existence risk is 0.13, and there is an unrisked mean estimate of 5.4 million cubic metres (34 million barrels) of recoverable oil. Gas existence risk is 0.13, and there is an unrisked mean estimate of 6.9 billion cubic metres (244 billion cubic feet) of recoverable gas.

If all prospects are drilled, there is a 50 percent chance of finding some oil and a 60 percent chance of finding some gas. Addition of the hypothetical resources gives a risked mean estimate for the three prospects of 4.5 million cubic metres (28 million barrels) of recoverable oil and 8.5 billion cubic metres (300 million cubic feet) of recoverable gas.

APPENDIX 1 - CALCULATION OF MEASURED AND INDICATED RESOURCES

Oil and gas resources were calculated using the following equations (Moody, 1961):

$$Vo = \frac{Vr \times \phi \times (1-Sw) \times Ro}{FVF}$$

$$Vg = \frac{Vr \times \phi \times (1-Sw) \times Rg}{Bg}$$

where $Bg = \frac{14.7}{P + 14.7} \times \frac{T}{520} \times Z$

Vr can be calculated by either $Vr = A \times TF$ or $Vr = Vt \times NP \times TF$

The variables used in the above expressions are defined as follows:

Vr = reservoir volume
Vt = trap volume
Vo = oil volume
Vg = gas volume
NP = fraction net pay
TF = fraction trap fill
ϕ = porosity
Sw = water saturation
Ro = oil recovery factor
Rg = gas recovery factor
P = reservoir pressure (p.s.i.g.)
T = reservoir temperature (degrees Rankine)
Z = gas deviation factor
A = reservoir area
FVF = formation volume factor
h = reservoir thickness
Bg = gas expansion factor

Puffin No. 1 and 3

$$Vo = \frac{166.6 \times 10^6 \times .27 \times .65 \times .17}{1.09}$$

$$= 4.56 \times 10^6 m^3$$

Puffin No.2

$$Vo = \frac{19.32 \times 10^6 \times .3 \times .88 \times .17}{1.09}$$

$$= 0.8 \times 10^6 m^3$$

Swan Compartment No. 1

$$Vg = \frac{1.13 \times 10^{6} \times 13.72 \times .19 \times .6 \times .71 \times 35.3 \times 3514.7}{640 \times 0.93}$$

$$= 261.57 \times 10^{6} m^{3}$$

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RESERVOIR PARAMETERS

Table 1

Trap	Trap Volume				Net Pay		Trap Fill		ϕ		S_w		Recovery Factor				Reservoir					Z Gas Dev. Fract		Formation Volume Factor	
	contours used	area km²	volume m³ x 10⁶	weight	fract	weight	fract	weight	fract	weight	fract	weight	oil fract	weight	gas fract	weight	depth m	T °R	weight	P psig	weight		weight		weight
Hypothetical																									
Swan		61		0	4·5	0	20	0	15	0	25	0													
compartments		100		1	14	1	80	1	19	1	30	1	17		67			633		3080		0·93			
2+3		140		0	30	0	100	0	22	0	40	0													
A-11		42		0	4·5	0	20	0	15	0	25	0													
		58		1	14	1	40	1	19	1	30	1	17		71			640		3430		0·93			
		67		0	30	0	80	0	22	0	40	0													
					Percent																				
Puffin			540	0	7	0	12·5	0	16	0	12	0													
East			1120	1	30	1	25	1	27	1	35	1	17		70			633		3322		0·93			
			2840	0	43	0	50	0	32	0	45	0													

EXISTENCE RISK PARAMETERS

Table 2

Trap	Source		Thermal History		Reservoir		Trap and Seal		Timing		Flushing		Oil vs Gas	
	risk	weight	risk	weight	risk	weight	risk	weight	risk	weight	risk	weight	oil	gas
HYPOTHETICAL RESOURCES														
Swan 2+3	1		1		0·9		0·9		1		1		1	2
A-11	0·7		1		0·7		0·6		1		0·9		1	1
Puffin East	1		1		1		0·3		1		1		2	1