

## **Norton Basin Play 2: Mid-Tertiary East Subbasin Fill**

### **Geological Assessment**

*GRASP UAI: AAAAAIAC*

*Play Area: 1,566 square miles*

*Play Water Depth Range: 35 – 75 feet*

*Play Depth Range: 4,600 -12,500 feet*

*Play Exploration Chance: 0.036*

<b>Play 2, Mid-Tertiary East Subbasin Fill, Norton Basin OCS Planning Area, 2006 Assessment, Undiscovered Technically-Recoverable Oil &amp; Gas</b>			
Assessment Results as of November 2005			
<b>Resource Commodity (Units)</b>	<b>Resources *</b>		
	<b>F95</b>	<b>Mean</b>	<b>F05</b>
BOE (Mmboe)	0	66	352
Total Gas (Tcfg)	0.000	0.334	1.794
Total Liquids (Mmbo)	0	6	33
Free Gas** (Tcfg)	0.000	0.334	1.794
Solution Gas (Tcfg)	0.000	0.000	0.000
Oil (Mmbo)	0	0	0
Condensate (Mmbc)	0	6	33
<i>* Risked, Technically-Recoverable</i> <i>** Free Gas Includes Gas Cap and Non-Associated Gas</i> <i>F95 = 95% chance that resources will equal or exceed the given quantity</i> <i>F05 = 5% chance that resources will equal or exceed the given quantity</i> <i>BOE = total hydrocarbon energy, expressed in barrels-of-oil-equivalent, where 1 barrel of oil = 5,620 cubic feet of natural gas</i> <i>Mmb = millions of barrels</i> <i>Tcf = trillions of cubic feet</i>			

**Table 1**

Play 2, the “Mid-Tertiary East Subbasin Fill” play, is the 3<sup>rd</sup>-ranking play (of 4 plays) in the Norton Basin OCS Planning Area, with 11% (66 Mmboe) of the planning area energy endowment (601 Mmboe). The overall assessment results for Play 2 are shown in [table](#)

1. Liquid hydrocarbons consisting of gas-condensates form 9% of the hydrocarbon energy endowment of this play. [Table 2](#) shows the conditional sizes of the 10 largest pools calculated in the *GRASP* computer model of the play. [Table 3](#) summarizes the volumetric input data developed for use in the Play 2 *GRASP* computer model. [Table 4](#) reports the risk model used for the play. [Table 5](#) reports the detailed Play 2 assessment results by commodity.

The location of Norton Basin Play 2, which is confined to the Stuart subbasin in the eastern portion of the Norton Basin area, is shown in [figure 1](#). Also shown are the Norton Basin COST (Continental Offshore Stratigraphic Test) #2 well and the 4 exploratory wells that were drilled in the Play 2 area. Only the Y-0414 well near the edge of the Yukon Horst failed to penetrate Play 2 sediments.

Norton Basin Play 2 consists of Eocene through lower Oligocene clastic sediments deposited in continental to transitional (Eocene) and transitional to middle neritic (lower Oligocene) environments. The most likely reservoir rocks within the play interval are intervals of delta plain to marginal marine sands in the lower Oligocene section. Porosities range 10% and higher, and can approach 30% in the shallower areas of the play.

Potential hydrocarbon charge for the play derives primarily from thermally mature gas-prone source rocks in the deeper parts of the play interval and in underlying Early Tertiary subbasin strata. The COST wells encountered numerous shales and coaly intervals in these rocks, which were shown to contain primarily humic type III gas-prone kerogen.

Hydrocarbon migration would be expected to be predominantly along horst and graben faulting systems within the basin. The most likely hydrocarbon trapping mechanisms include anticlines, faulted anticlines, fault traps, and stratigraphic traps formed by onlap against basement. Common shale intervals provide adequate seals.

Play 2, Mid-Tertiary East Subbasin Fill, Norton Basin OCS Planning Area, 2006 Assessment, Conditional BOE Sizes of Ten Largest Pools			
Assessment Results as of November 2005			
Pool Rank	BOE Resources *		
	F95	Mean	F05
1	14	146	457
2	5	49	144
3	2.9	26	74
4	2.0	17	46
5	1.5	12	33
6	1.25	9	25
7	1.07	7	20
8	0.95	6.2	16
9	0.85	5.4	14
10	0.74	4.7	12
* Conditional, Technically-Recoverable, Millions of Barrels Energy-Equivalent (Mmboe), from "PSRK.out" file F95 = 95% chance that resources will equal or exceed the given quantity F05 = 5% chance that resources will equal or exceed the given quantity BOE = total hydrocarbon energy, expressed in barrels-of-oil- equivalent, where 1 barrel of oil = 5,620 cubic feet of natural gas			

**Table 2.**

A maximum of 17 hypothetical pools (tbl. 3) is forecast by the aggregation of the risk model (tbl. 4) and the prospect numbers model for Play 2. These pools range in mean conditional (un-risked) recoverable volumes from 2.3 Mmboe (pool rank 17) to 146 Mmboe (pool rank 1, tbl. 2). Possible conditional recoverable volumes for pool rank 1 range from 14 Mmboe (F95) to 457 Mmboe (F05).

In the computer simulation for Play 2 a total of 13,477 "simulation pools" were sampled for size. These simulation pools can be grouped according to the USGS size class system in which sizes double with each successive class. Table 6 reports the size classes and statistics for the simulation pools (conditional, technically recoverable BOE resources) developed in the GRASP computer model for Norton Basin Play 2. Pool size class 10 contains the largest share (2,792, or 21%) of simulation pools for the play. Pool size class 10 ranges from 16 to 32 Mmboe. The largest simulation pool for Play 2 falls within pool size class 17, which ranges in size from 2,048 to 4,096 Mmboe.

Producible hydrocarbons were not encountered in any of the wells that penetrated Play 2.

## GRASP Play Data Form (Minerals Management Service-Alaska Regional Office)

Basin: Norton  
Play Number: 2  
Play UAI Number: AAAAAIAC

Assessor: S Banet  
Play Name: Mid-Tertiary East Subbbasin Fill

Date: March, 2006

Play Area: mi<sup>2</sup> ( million acres) 1566 mi<sup>2</sup> ; 1.0022 million acres  
Reservoir Thermal Maturity: % Ro 0.4 - 0.5 - 0.7

Play Depth Range: feet 4,600 - 8,500 - 12,500  
Expected Oil Gravity: ° API 45  
Play Water Depth Range: feet 35 - 75  
Prospect distance from shore: miles: 28 - 60 - 99

### POOLS Module (Volumes of Pools, Acre-Feet)

Fractile	F100	F95	F90	F75	F50	Mean/Std. Dev.	F25	F15	F10	F05	F02	F01	F00
Prospect Area (acres)-Model Input*	35	526.5059	800.0303	1609.6245	3499.9865	8022.6 / 12282	7610.4117	11546.0113	15311.8013	23266.4175	37259.4045	51000.5148	130000
Prospect Area (acres)-Model Output**													
Fill Fraction (Fraction of Area Filled)*	0.1	0.2005	0.2223	0.2642	0.32	.33803 / .11079	0.3876	0.4297	0.4607	0.5108	0.5738	0.62	1
Productive Area of Pool (acres)***	10	148.508	235.601	509.424	1199.997	2759.539 / 5341.945	2826.04	4476.694	6112.006	9696.369	16299.97	23044.85	62000
Pay Thickness (feet)	40	99.635	109.058	126.833	150	154.75 / 39.597	177.399	194.11	206.313	225.825	250	323.523	350

\* model fit to prospect area, fill fraction data from NA95 in *BESTFIT*

\*\* output from @RISK after aggregation with fill fraction

\*\*\* from @RISK aggregation of probability distributions for prospect area and fill fraction

### MPRO Module (Numbers of Pools)

Input Play Level Chance	0.3
Output Play Level Chance*	0.2968

Prospect Level Chance	0.12
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Exploration Chance	0.036
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\* First Occurrence of Non Zero Pools As Reported in PSUM Module

Risk Model

Play Chance	Petroleum System Factors	Prospect Chance
0.6	Presence of trap with minimum rock volume	
0.5	Effective seal mechanism for trap	
	Efficient source rock with sufficient volume, maturity, drainage	0.12

Fractile	F99	F95	F90	F75	F50	Mean/Std. Dev.	F25	F15	F10	F05	F02	F01	F00
Numbers of Prospects in Play	27	30	31	33	37	37.46 / 4.8	40	42	43	45	48	49	55
Numbers of Pools in Play					0	1.35 / 2.35	2	4	5	6	8	9	17

Minimum Number of Pools	0	Mean Number of Pools	1.35	Maximum Number of Pools	17
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### POOLS/PSRK/PSUM Modules (Play Resources)

Fractile	F100	F95	F90	F75	F50	Mean/Std. Dev.	F25	F15	F10	F05	F02	F01	F00
Oil Recovery Factor (bbl/acre-foot)	0	constant											
Gas Recovery Factor (Mcfg/acre-foot)	203	362.795	401.331	475.073	573	595.867 / 171.337	691.113	764.235	818.1	904.999	1013.892	1093.674	1610
Gas Oil Ratio (Sol'n Gas)(cf/bbl)	0	constant											
Condensate Yield ((bbl/Mmcfg)	7.5	12.96	13.935	15.731	18	18.358 / 3.732	20.596	22.14	23.25	25	27.127	28.645	33

Pool Size Distribution Statistics from POOLS (1,000 BOE):  $\mu$  (mu)= 9.91788881  $\sigma^2$  (sigma squared)= 1.78984256 Random Number Generator Seed = 449406

BOE Conversion Factor (cf/bbl)	5620	Probability Any Pool Contains Both Oil and Free Gas (Gas Cap)	0
Probability Any Pool is 100% Oil	0	Fraction of Pool Volume Gas-Bearing in Oil Pools with Gas Cap	1
Probability Any Pool is 100% Gas	1		

Table 3. Input data for Norton basin play 2, 2006 assessment.



# GRASP - Geologic and Economic Resource Assessment Model - PSUM Module Results

Minerals Management Service - Alaska OCS Region

GRASP Model Version: 8.29.2005)

Computes the Geologic Resource Potential of the Play

<b>Play UAI: AAAAAIAC</b>			<b>Play No. 2</b>		<b>Resources</b>	
World	Level	-	World	Level	OF	AMERICA
Country	Level	-	UNITED	STATES	ALASKA	REGION
Region	Level	-	MMS	-		
Basin	Level	-	<b>NORTON</b>	<b>BASIN</b>		
<b>Play</b>	<b>Level</b>	-	<b>Play</b>		<b>2 Mid-Tertiary East Subbasin Fill Play</b>	
Geologist	Sue	Banet				
Run Date & Time:	Date	19-Sep-05	Time	14:09:04		

## Summary of Play Potential

Product	MEAN	Standard Deviation
BOE (Mboe)	65,553	161,890
Oil (Mbo)	0	0
Condensate (Mbc)	6,161	15,561
Free (Gas Cap & Nonassociated) Gas (Mmcfg)	333,790	823,510
Solution Gas (Mmcfg)	0	0

10000 (Number of Trials in Sample)

0.2968 (MPHc [Probability] of First Occurrence of Non-Zero Resource)

Windowing Feature: used

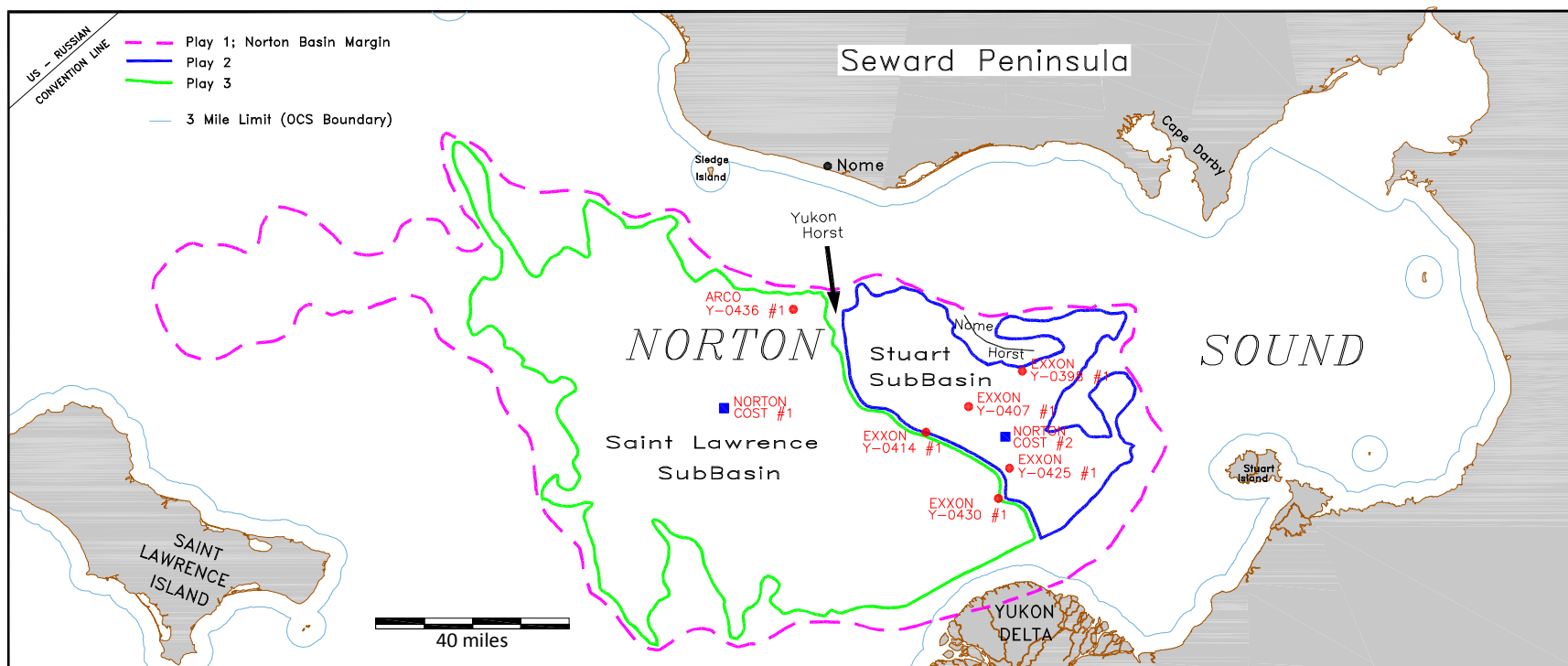
## Empirical Probability Distributions of the Products

Greater Than Percentage	BOE (Mboe)	Oil (Mbo)	Condensate (Mbc)	Free (Gas Cap & Nonassociated) Gas (Mmcfg)	Solution Gas (Mmcfg)
100	0	0	0	0	0
99.99	0	0	0	0	0
99	0	0	0	0	0
95	0	0	0	0	0
90	0	0	0	0	0
85	0	0	0	0	0
80	0	0	0	0	0
75	0	0	0	0	0
70	0	0	0	0	0
65	0	0	0	0	0
60	0	0	0	0	0
55	0	0	0	0	0
50	0	0	0	0	0
45	0	0	0	0	0
40	0	0	0	0	0
35	0	0	0	0	0
30	613	0	57	3,126	0
25	52,621	0	4,955	267,880	0
20	99,661	0	9,406	507,230	0
15	152,530	0	14,344	776,580	0
10	226,630	0	21,112	1,155,000	0
8	266,400	0	25,360	1,354,700	0
6	318,900	0	30,023	1,623,500	0
5	352,090	0	32,891	1,793,900	0
4	397,080	0	36,797	2,024,800	0
2	558,560	0	53,424	2,838,900	0
1	800,410	0	74,939	4,077,100	0
0.1	1,549,800	0	141,220	7,916,400	0
0.01	2,320,200	0	213,430	11,840,000	0
0.001	2,437,100	0	322,910	11,882,000	0

Table 5. Assessment results by commodity for Norton basin play 2, 2006 assessment.

Basin: NORTON BASIN Play 02 - Mid-Tertiary East Subbasin Fill Play UAI Key: AAAAAIAC				Model Simulation "Pools" Reported by "Fieldsize.out" GRASP Module																			
Classification and Size				Pool Count Statistics			Pool Types Count			Mixed Pool Range		Oil Pool Range		Gas Pool Range		Total Pool Range		Pool Resource Statistics (MMBOE)					
Class	Min (MMBOE)	Max (MMBOE)	Pool Count	Percentage	Trial Average	Trials w/Pool Avg	Mixed Pool	Oil Pool	Gas Pool	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Total Resource	Average Resource		
1	0.0312	0.0625	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000		
2	0.0625	0.125	1	0.00742	0.0001	0.000337	0	0	1	0	0	0	0	0	1	1	1	0.114276	0.114276	0.114276	114.275962		
3	0.125	0.25	7	0.05194	0.0007	0.002358	0	0	7	0	0	0	0	0	1	1	1	0.144129	0.213445	1.356509	193.786979		
4	0.25	0.5	32	0.237442	0.0032	0.010778	0	0	32	0	0	0	0	0	1	2	1	0.251019	0.499602	11.944632	373.269737		
5	0.5	1	129	0.957186	0.0129	0.043449	0	0	129	0	0	0	0	0	1	1	1	0.500700	0.996574	97.474246	755.614340		
6	1	2	382	2.834459	0.0382	0.128663	0	0	382	0	0	0	0	0	1	3	1	1.003323	1.997659	588.926243	1.541692		
7	2	4	964	7.152927	0.0964	0.324688	0	0	964	0	0	0	0	0	1	5	1	2.007118	3.999950	2926.256000	3.035535		
8	4	8	1768	13.118647	0.1768	0.595487	0	0	1768	0	0	0	0	0	1	4	1	4.004943	7.996798	10448.678000	5.909886		
9	8	16	2448	18.16428	0.2448	0.82452	0	0	2448	0	0	0	0	0	1	6	1	8.006247	15.999886	28579.414000	11.674598		
10	16	32	2792	20.716776	0.2792	0.940384	0	0	2792	0	0	0	0	0	1	7	1	16.000401	31.999357	63848.390000	22.868334		
11	32	64	2326	17.259033	0.2326	0.783429	0	0	2326	0	0	0	0	0	1	6	1	32.011114	63.991378	105815.842000	45.492622		
12	64	128	1566	11.619797	0.1566	0.52745	0	0	1566	0	0	0	0	0	1	4	1	64.006391	127.940241	140021.117000	89.413231		
13	128	256	704	5.223714	0.0704	0.237117	0	0	704	0	0	0	0	0	1	3	1	128.124580	255.286367	124374.196000	176.667892		
14	256	512	248	1.840172	0.0248	0.08353	0	0	248	0	0	0	0	0	1	2	1	256.995646	510.039688	85154.052000	343.363129		
15	512	1024	87	0.645544	0.0087	0.029303	0	0	87	0	0	0	0	0	1	2	1	517.956395	1021.727000	64071.891000	736.458496		
16	1024	2048	21	0.155821	0.0021	0.007073	0	0	21	0	0	0	0	0	1	1	1	1055.357000	1513.640000	25037.209000	1.192248		
17	2048	4096	2	0.01484	0.0002	0.000674	0	0	2	0	0	0	0	0	1	1	1	2124.830000	2431.665000	4556.495000	2.278247		
18	4096	8192	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000		
19	8192	16384	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000		
20	16384	32768	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000		
21	32768	65536	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000		
22	65536	131072	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000		
23	131072	262144	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000		
24	262144	524288	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000		
25	524288	1048576	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000		
Not Classified			0	0	0	0	Below Class		0	0	0	Below Class		0	0	0	0	0.000000	0.000000	0.000000	0.000000		
Totals			13477	100	1.3477	4.539238	Above Class		0	0	0	Above Class		0	0	0	0	0.000000	0.000000	0.000000	0.000000		
Number of Pools not Classified: 0				Min and Max refer to numbers of pools of the relevant size class that occur within any single trial in the simulation.																Min and Max refer to aggregate resources of the relevant size class that occur within any single trial in the simulation.			
Number of Pools below Class 1: 0																							
Number of Trials with Pools: 2969																							

Table 6. Statistics for simulation pools created in computer sampling run for Norton basin play 2, 2006 assessment.



**Figure 1. Norton Basin Play 2, the Mid-Tertiary East Subbasin Fill play (2006 assessment) which occupies the Stuart Subbasin in the eastern portion of the Norton Basin. Five wells (the Norton Basin COST #2 and the Exxon Y-0398, 0407, 0414, and Y0425 wells) were drilled in the Play 2 area. Play 2 sediments are not present in the Y-0414 well.**