

## Gulf of Alaska Play 4: Yakutat Shelf-Kulthieth Sands Play

### Geological Assessment

*GRASP UAI: AAAAAEAF*

*Play Area: 6,500 square miles*

*Play Water Depth Range: 200-980 feet*

*Play Depth Range: 3,300-14,250 feet*

*Play Exploration Chance: 0.2016*

Play 4, Yakutat Shelf-Kulthieth Sands, Gulf of Alaska OCS Planning Area, 2006 Assessment, Undiscovered Technically-Recoverable Oil & Gas			
Assessment Results as of November 2005			
Resource Commodity (Units)	Resources *		
	F95	Mean	F05
BOE (Mmboe)	0	646	1,956
Total Gas (Tcfg)	0.000	1.943	6.035
Total Liquids (Mmbo)	0	300	882
Free Gas** (Tcfg)	0.000	1.729	5.424
Solution Gas (Tcfg)	0.000	0.214	0.610
Oil (Mmbo)	0	209	599
Condensate (Mmbc)	0	91	283
* Risked, Technically-Recoverable ** Free Gas Includes Gas Cap and Non-Associated Gas 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 Mmb = millions of barrels Tcf = trillions of cubic feet			

**Table 1**

Play 4, the “Yakutat Shelf-Kulthieth Sands” play, is the most important play (of six plays) in the Gulf of Alaska OCS Planning Area, with 44% (646 Mmboe) of the Planning Area energy endowment (1,454 Mmboe). The overall assessment results for play 4 are shown in [table 1](#). Oil and gas-

condensate liquids form 46% of the hydrocarbon energy endowment of play 4. [Table 5](#) reports the detailed assessment results by commodity for play 4.

[Table 3](#) summarizes the volumetric input data developed for the GRASP computer model of Gulf of Alaska play 4. [Table 4](#) reports the risk model used for play 4. The location of play 4 is shown in [figure 1](#).

Play 4 partly underlies play 3, mostly in the northern Yakutat shelf area, and is confined to the Eocene Kulthieth Formation. Play 4 has the same northwestern limit as the overlying play 3, but does not extend as far southeast as it pinches out against basement rocks. Trapping mechanisms are similar to those of overlying play 3, but with additional potential for unconformity and stratigraphic traps along the southeast margin and for fault traps in the southeastern corner of the play area near the Fairweather Ground uplift and rift zone ([fig. 1](#)).

Potential source rocks for play 4 consist of nonmarine/deltaic to basinal marine sediments in the lower part of the Kulthieth Formation and its equivalents. According to Van Kooten and Short (2006), oil-prone coals in the Kulthieth Formation are responsible for numerous onshore oil seeps between Cape Yakataga and the Samovar Hills. This section was marginally immature in the ARCO Y-0211 (Yakutat No. 1) well, where the top of the oil window occurred at about 12,000 feet (Risley and others, 1992). However, this unit is projected to be mature for oil generation to the west, where it is buried more deeply.

Relatively thick sandstones with reservoir rock potential occur higher in the Kulthieth Formation. The ARCO Y-0211 (Yakutat No. 1) well encountered sandstones near the top of the Kulthieth section with thicknesses of 50 to 150 feet, porosities greater than 20 percent, and permeabilities of 10 to 20 millidarcies (Risley and others, 1992). Minor oil and gas shows were reported in Kulthieth Formation sandstones in that well.

<b>Play 4, Yakutat Shelf-Kulthieth Sands, Gulf of Alaska OCS Planning Area, 2006 Assessment, Conditional BOE Sizes of Ten Largest Pools</b>			
Assessment Results as of November 2005			
Pool Rank	BOE Resources *		
	F95	Mean	F05
1	54	612	2072
2	25	155	405
3	13	84	227
4	8	54	137
5	5	37	96
6	3.1	27	72
7	2.3	20	55
8	1.8	16	44
9	1.5	13	36
10	1.3	11	30
* 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 32 hypothetical pools is forecast by the aggregation of the risk model and the prospect numbers model for play 4. These 32 pools range in mean conditional (un-risked) recoverable volumes from 1.6 Mmboe (pool rank 32) to 612 Mmboe (pool rank 1). Pool rank 1 ranges in possible conditional recoverable volumes from 54 Mmboe (F95) to 2,072 Mmboe (F05), or in a gas case from 0.303 Tcfge (F95) to 11.645

Tcfge (F05). [Table 2](#) shows the conditional sizes of the 10 largest pools in play 4.

In the computer simulation for play 4 a total of 72,751 "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. Pool size class 10 contains the largest share (13,153, or 18%) of simulation pools (conditional, technically recoverable BOE resources) for play 4. Pool size class 10 ranges from 16 to 32 Mmboe. The largest simulation pool for play 4 falls within pool size class 19, which ranges in size from 8,192 to 16,384 Mmboe (or 46 to 92 Tcfge). [Table 6](#) reports statistics for the simulation pools developed in the *GRASP* computer model for play 4.

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

Basin: Gulf of Alaska  
 Play Number: 4  
 Play UAI Number: AAAAAEAF

Assessor: Comer / Larson  
 Play Name: Yakutat Shelf - Kulthieth Sands

Date: March, 2005

Play Area (mi<sup>2</sup>; millions of acres): 6,500 mi<sup>2</sup>, 4.16 million acres  
 Reservoir Thermal Maturity, % Ro: 0.2 - 1.1

Play Depth Range, feet: 3,300 - 6,900 - 14,250  
 Expected Oil Gravity, ° API: 35  
 Play Water Depth Range, feet: 200 - 340 - 980  
 Prospect Distance from shore, miles: 6 - 20 - 54

### 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	0				5000	---					38000		-
Prospect Area (acres)-Model Output	100	985	1410	2569	5000	8142.1 / 10464.3	9733	13915	17726	25376	38000	49739	69000
Fill Fraction (Fraction of Area Filled)	0.08	0.158	0.182	0.23	0.3	0.32386 / 0.13171	0.391	0.45	0.495	0.571	0.67	0.745	0.95
Productive Area of Pool (acres)	24	238	357	703	1490	2828.75 / 4465.92	3160	4730	6216	9319	14700	19919	58800
Pay Thickness (feet)	4	27	38	65	120	182.316 / 212.436	220	305	380	526	760	971	3395

### MPRO Module (Numbers of Pools)

Play Level Chance	0.8	Prospect Level Chance	0.27	Exploration Chance	0.216
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Risk Model	Play Chance	Petroleum System Factors	Prospect Chance
		[ See Risking Form ]	

Fractile	F100	F95	F90	F75	F50	Mean / Std. Dev.	F25	F15	F10	F05	F02	F01	F00
Numbers of Prospects in Play	14	22	24	28	32	33.68 / 7.65	38	41	43	47	51	55	79
Numbers of Pools in Play	~	~	F79.99 = 0	4	8	7.28 / 4.69	10	12	13	14	16	18	32

Minimum Number of Pools	0	Mean Number of Pools	7.28	Maximum Number of Pools	32
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### POOLS/PSRK/PSUM Module (Play Resources)

Fractile	F100	F95	F90	F75	F50	Mean / Std. Dev.	F25	F15	F10	F05	F02	F01	F00
Oil Recovery Factor (bbl/acre-foot)	47	97	110	137	174	185.508 / 69.019	221	251	274	312	360	397	650
Gas Recovery Factor (Mcfg/acre-foot)	70	222	272	382	557	635.568 / 405.101	812	993	1139	1395	1752	2040	4460
Gas Oil Ratio (Sol'n Gas)(cf/bbl)	300	526	600	750	960	1026.078 / 387.537	1229	1403	1535	1753	2036	2250	2760
Condensate Yield (bbl/Mmcfg)	20	40	42	47	52	52.646 / 8.460	58	61	64	67	72	75	100

Pool Size Distribution Statistics from POOLS (1,000 BOE):  $\mu$  (mu) = 10.2620945  $\sigma^2$  (sigma squared) = 2.24130442 Random Number Generator Seed = 870384

BOE Conversion Factor (cf/bbl)	5620	Probability Any Pool Contains Both Oil and Free Gas (Gas Cap)	1
Probability Any Pool is 100% Oil	0	Fraction of Pool Volume Gas-Bearing in Oil Pools with Gas Cap	0.7
Probability Any Pool is 100% Gas	0		

Table 3. Input data for Gulf of Alaska play 4, 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: AAAAAEAF</b>	<b>Play No. 4</b>
World Level -	World Level Resources
Country Level -	UNITED STATES OF AMERICA
Region Level -	MMS ALASKA REGION
Basin Level -	<b>GULF OF ALASKA</b>
<b>Play Level -</b>	<b>4 Yakutat Shelf - Kulthieth Sands</b>
Geologist Larson, Comer	
Remarks Play	4 Yakutat Shelf; Kulthieth Sandstone
Run Date & Time: Date	19-Sep-05 Time 14:03:22

## Summary of Play Potential

Product	MEAN	Standard Deviation
<b>BOE (Mboe)</b>	646,130	811,190
<b>Oil (Mbo)</b>	209,060	256,260
<b>Condensate (Mbc)</b>	91,364	127,100
<b>Free (Gas Cap &amp; Nonassociated) Gas (Mmcfg)</b>	1,729,200	2,354,800
<b>Solution Gas (Mmcfg)</b>	213,650	274,980

10000 (Number of Trials in Sample)

0.7996 (MPhc [Probability] of First Occurrence of Non-Zero Resource)

Windowing Feature: used

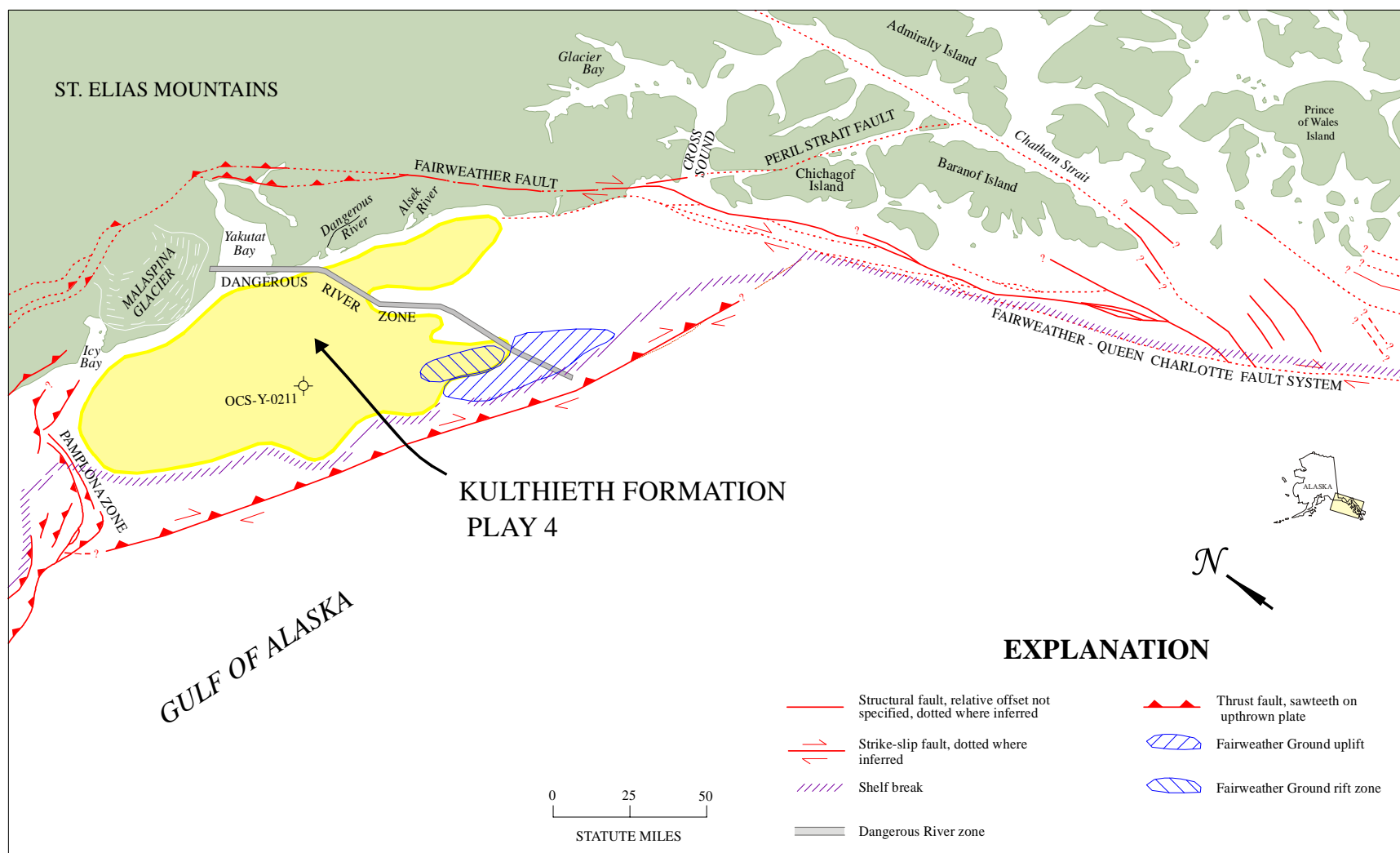
## Empirical Probability Distributions of the Products

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	11,361	4,377	1,401	27,116	4,261
75	143,510	49,534	19,368	366,960	52,329
70	217,200	75,596	29,083	556,300	76,051
65	280,290	96,650	37,520	725,490	95,688
60	337,770	113,590	46,573	881,680	116,470
55	397,730	135,750	54,106	1,032,100	136,180
50	453,530	155,810	61,661	1,167,600	159,030
45	516,500	169,150	72,499	1,369,900	174,770
40	584,570	194,260	80,647	1,539,700	200,620
35	658,370	215,210	92,883	1,743,200	225,370
30	747,620	245,350	104,100	1,997,200	240,520
25	864,340	289,650	119,930	2,269,900	285,830
20	996,790	331,760	137,100	2,623,100	343,890
15	1,181,900	375,910	168,520	3,194,400	387,930
10	1,461,200	476,510	206,800	3,906,700	465,270
8	1,615,300	531,660	228,350	4,247,400	559,060
6	1,813,900	584,770	256,440	4,867,100	599,410
5	1,956,200	599,290	283,150	5,424,300	610,340
4	2,156,000	710,790	304,400	5,701,800	709,430
2	2,935,800	900,250	427,770	8,092,800	942,690
1	3,777,500	1,102,400	568,480	10,721,000	1,118,100
0.1	7,623,100	1,254,900	1,537,900	25,724,000	1,421,900
0.01	14,450,000	2,761,900	2,421,800	49,121,000	2,956,000
0.001	15,174,000	3,119,700	2,484,000	50,488,000	3,296,100

**Table 5.** Assessment results by commodity for Gulf of Alaska play 4, 2006 assessment.

Basin: GULF OF ALASKA Play 04 - Yakutat Shelf - Kulthieth Sands UAI Key: AAAAAEAF							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	5	0.006873	0.0005	0.000625		5	0	0	1	1	0	0	0	0	1	1		0.040186	0.060328	0.246639	49.327809		
2	0.0625	0.125	2	0.002749	0.0002	0.00025		2	0	0	1	1	0	0	0	0	1	1		0.104709	0.113310	0.218019	109.009303		
3	0.125	0.25	44	0.06048	0.0044	0.005502		44	0	0	1	1	0	0	0	0	1	1		0.132039	0.248153	8.428473	191.556200		
4	0.25	0.5	191	0.262539	0.0191	0.023884		191	0	0	1	2	0	0	0	0	1	2		0.256406	0.494729	75.310342	394.294977		
5	0.5	1	676	0.929197	0.0676	0.084532		676	0	0	1	2	0	0	0	0	1	2		0.501098	0.999953	519.565124	768.587470		
6	1	2	1922	2.641888	0.1922	0.24034		1922	0	0	1	4	0	0	0	0	1	4		1.000194	1.999477	2881.359000	1.499146		
7	2	4	4044	5.558686	0.4044	0.50569		4044	0	0	1	5	0	0	0	0	1	5		2.000667	3.998979	12108.673000	2.994232		
8	4	8	7333	10.079587	0.7333	0.916969		7333	0	0	1	7	0	0	0	0	1	7		4.002100	7.999845	43259.649000	5.899311		
9	8	16	11135	15.305632	1.1135	1.392397		11135	0	0	1	8	0	0	0	0	1	8		8.000902	15.999178	130406.469000	11.711403		
10	16	32	13153	18.079477	1.3153	1.644742		13153	0	0	1	9	0	0	0	0	1	9		16.001806	31.996137	305213.054000	23.204824		
11	32	64	12631	17.361961	1.2631	1.579467		12631	0	0	1	9	0	0	0	0	1	9		32.000200	63.995388	578903.931000	45.831997		
12	64	128	10257	14.098775	1.0257	1.282606		10257	0	0	1	9	0	0	0	0	1	9		64.005648	127.988874	927706.616000	90.446198		
13	128	256	6151	8.454866	0.6151	0.769163		6151	0	0	1	5	0	0	0	0	1	5		128.003754	255.986469	1098570.000000	178.600296		
14	256	512	3247	4.463169	0.3247	0.406027		3247	0	0	1	4	0	0	0	0	1	4		256.067314	511.510162	1146206.000000	353.004761		
15	512	1024	1305	1.79379	0.1305	0.163186		1305	0	0	1	3	0	0	0	0	1	3		512.026383	1023.069000	912778.100000	699.446838		
16	1024	2048	468	0.64329	0.0468	0.058522		468	0	0	1	3	0	0	0	0	1	3		1024.166000	2046.622000	645849.847000	1.380021		
17	2048	4096	156	0.21443	0.0156	0.019507		156	0	0	1	2	0	0	0	0	1	2		2052.223000	4017.836000	448490.657000	2.874940		
18	4096	8192	25	0.034364	0.0025	0.003126		25	0	0	1	1	0	0	0	0	1	1		4142.516000	7426.278000	133912.380000	5.356495		
19	8192	16384	6	0.008247	0.0006	0.00075		6	0	0	1	1	0	0	0	0	1	1		11010.128000	13873.347000	74421.453000	12.403575		
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	0.000000	0.000000	0.000000	0.000000		
Totals			72751	100	7.2751	9.097287	Above Class	0	0	0									Above Class	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.																		
Number of Pools below Class 1: 0																									
Number of Trials with Pools: 7997																									

**Table 6.** Statistics for simulation pools created in computer sampling run for Gulf of Alaska play 4, 2006 assessment.



**Figure 1.** Map location of Gulf of Alaska play 4, 2006 assessment.