Gulf of Alaska Play 6: Subducting Terrane Play

Geological Assessment

GRASP UAI: AAAAAEAH
Play Area: 1,800 square miles
Play Water Depth Range: 60-720 feet
Play Depth Range: 3,000-15,000 feet
Play Exploration Chance: 0.225

Play 6, Subducting Terrane, 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	134	473
Total Gas (Tcfg)	0.000	0.315	1.098
Total Liquids (Mmbo)	0	78	277
Free Gas** (Tcfg)	0.000	0.250	0.865
Solution Gas (Tcfg)	0.000	0.066	0.233
Oil (Mmbo)	0	64	231
Condensate (Mmbc)	0	13	46

** 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 6, the "Subducting Terrane" play, is the fourth most important (of six plays) in the Gulf of Alaska OCS Planning Area energy endowment, with 9% (134 Mmboe) of the Planning Area energy endowment (1,454 Mmboe). At 1,800 square miles, it is the smallest in area of all six plays. The overall assessment results for play 6 are shown in table 1. Oil and gas-condensate liquids form 58% of the hydrocarbon energy endowment of play 6. Table 5 reports the detailed assessment results by commodity for play 6.

Table 3 summarizes the volumetric input data developed for the *GRASP* computer model of Gulf of Alaska play 6. Table 4 reports the risk model used for play 6. The location of play 6 is shown in figure 1.

Play 6 is located in the offshore area surrounding Kayak Island. In this area, Eocene to Miocene sedimentary rocks are apparently being subducted along the Kayak zone, or underthrust to the north and west beneath the "basement" rocks (deformed Orca Group metasediments) of the Prince William terrane. Oil and gas in seeps that occur along the onshore extension of the Kayak zone at Katalla are thought to originate at depth in the area, generated from subducted Poul Creek and Kultheith Formation source rocks and then migrated upward along fractures and fault surfaces.

Traps in this play are likely to consist of extensively folded and faulted structures similar to those exposed on Kayak Island. Hydrocarbon accumulations might also occur in up-dip stratigraphic/structural traps along the southeast margin of the play area. Potential reservoir rocks are Kulthieth and Yakataga Formation sandstones, perhaps with fracture-enhanced permeabilities. Oil was produced from fractured shales and siltstones of the Poul Creek Formation in the abandoned Katalla field onshore.

A maximum of 16 hypothetical pools is forecast by the aggregation of the risk model

and the prospect numbers model for play 6. These 16 pools range in mean conditional (un-risked) recoverable volumes from 1.5 Mmboe (pool rank 16) to 137 Mmboe (pool rank 1). Pool rank 1 ranges in possible conditional recoverable volumes from 9 Mmboe (F95) to 402 Mmboe (F05), or in a gas case from 0.05 Tcfge (F95) to 2.259 Tcfge (F05). Table 2 shows the conditional sizes of the 10 largest pools in play 6.

Play 6, Subducting Terrane, Gulf of Alaska 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	9	137	402
2	3	37	115
3	1.63	18	55
4	1.06	11	33
5	0.80	8	23
6	0.65	6	17
7	0.56	5	13
8	0.50	3.9	11
9	0.43	3.3	9
10	0.37	2.9	8

** 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

In the computer simulation for play 6 a total of 31,315 "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 9 contains the largest share (5,994, or 19%) of simulation pools (conditional, technically recoverable BOE resources) for play 6. Pool size class 9 ranges from 8 to 16 Mmboe.

The largest simulation pool for play 6 falls within pool size class 18, which ranges in size from 4,096 to 8,192 Mmboe (or 23 to 46 Tcfge). Table 6 reports statistics for the simulation pools developed in the *GRASP* computer model for play 6.

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

Basin: Gulf of Alaska
Play Number: 6
Play UAI Number: AAAAAEAH

Assessor: Comer / Larson
Play Name: Subducting Terrane

Date: March, 2005

Play Area (mi^2; millions of acres): 1,800 mi^2, 1.152 million acres
Reservoir Thermal Maturity, % Ro: 0.4 - 0.6+

Play Depth Range, feet: 3,000 - 8,000 - 15,000
Expected Oil Gravity, ^{o} API: 35
Play Water Depth Range, feet: 60 - 300 - 720
Prospect Distance from Shore, miles: 3 - 16 - 23

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	~				3700	~~~					30000		~
Prospect Area (acres)-Model Output	150	692	1002	1861	3700	6218.7 / 8400.6	7357	10639	13658	19777	30000	39606	56500
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)	15	165	251	508	1110	2220.14 / 3724.92	2426	3690	4903	7470	12000	16459	48000
Pay Thickness (feet)	5	28	37	59	100	137.301 / 131.204	170	225	273	363	500	619	1844

MPRO Module (Numbers of Pools)

Play Level Chance	0.75	Prospect Level Chance	0.3	Exploration Chance	0.225

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	8	9	10	11	13	13.92 / 2.74	15	16	17	18	20	21	28
Numbers of Pools in Play	~	~	F74.21 = 0	F70 = 2	3	3.13 / 2.44	5	6	6	7	8	9	16

Minimum Number of Pools	0	Mean Number of Pools	3.13	Maximum Number of Pools	16

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)	32	72	84	106	139	150.647 / 63.377	182	210	231	267	314	350	609
Gas Recovery Factor (Mcfg/acre-foot)	53	166	202	281	406	472.652 / 284.370	586	714	815	994	1241	1440	3080
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): **μ (mu) =** 9.59730051 **σ^2 (sigma squared) =** 2.10296676

Random Number Generator Seed = 25460*

BOE Conversion Factor (cf/bbl)	5620
Probability Any Pool is 100% Oil	0
Probability Any Pool is 100% Gas	0

Probability Any Pool Contains Both Oil and Free Gas (Gas Cap)	1
Fraction of Pool Volume Gas-Bearing in Oil Pools with Gas Cap	0.55

Table 3. Input data for Gulf of Alaska play 6, 2006 assessment.

Risk Analysis Form - 2005 National Assessment

Assessment Province:	Gulf of Alaska	**Play Number, Name:**	6, Subducting Terrane
Assessor(s):	Comer & Larson	**Play UAI:**	AAAAAEAH
Date:	13-Oct-05		

For each component, a *quantitative* probability of success (i.e., between zero and one, where zero indicates no confidence and one indicates absolute certainty) based on consideration of the *qualitative* assessment of **ALL** elements within the component was assigned. This is the assessment of the probability that the minimum geologic parameter assumptions have been met or exceeded.

			Play Chance Factors	Averge Conditional Prospect Chance[1]
1.	**Hydrocarbon Fill component** (1a * 1b * 1c)	**1**	***1.0000***	***0.7500***
	a. Presence of a Quality, Effective, Mature Source Rock			
	Probability of efficient source rock in terms of the existence of sufficient volume of mature source rock of adequate quality located in the drainage area of the reservoirs.	1a	1.00	1.00
	b. Effective Expulsion and Migration			
	Probability of effective expulsion and migration of hydrocarbons from the source rock to the reservoirs.	1b	1.00	0.75
	c. Preservation			
	Probability of effective retention of hydrocarbons in the prospects after accumulation.	1c	1.00	1.00
2.	**Reservoir component** (2a * 2b)	**2**	***0.7500***	***0.5000***
	a. Presence of reservoir facies			
	Probability of presence of reservoir facies with a minimum net thickness and net/gross ratio (as specified in the resource assessment).	2a	0.75	1.00
	b. Reservoir quality			
	Probability of effectiveness of the reservoir, with respect to minimum effective porosity, and permeability (as specified in the resource assessment).	2b	1.00	0.50
3.	**Trap component** (3a * 3b)	**3**	***1.0000***	***0.8000***
	a. Presence of trap			
	Probability of presence of the trap with a minimum rock volume (as specified in the resource assessment).	3a	1.00	0.80
	b. Effective seal mechanism			
	Probability of effective seal mechanism for the trap.	3b	1.00	1.00

Overall Play Chance (Marginal Probability of hydrocarbons, MPhc)	***0.7500***	
(1 * 2 * 3) *Product of All Subjective Play Chance Factors*		
Average Conditional Prospect Chance[1]		***0.3000***
(1 * 2 * 3) *Product of All Subjective Conditional Prospect Chance Factors*		
[1] Assumes that the Play exists (where all play chance factors = 1.0)		
Must be consistent with play chance and prospect distribution -- See discussion on Page 3 of Guide		
Exploration Chance	***0.2250***	
(Product of Overall Play Chance and Average Conditional Prospect Chance)		

Comments: *See guidance document for explanation of the Risk Analysis Form*

Table 4. Risk model for Gulf of Alaska play 6, 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

Play UAI:	**AAAAAEAH**		**Play No.**		**6**			
World	Level	-	World	Level	Resources			
Country	Level	-	UNITED	STATES	OF	AMERICA		
Region	Level	-	MMS	-	ALASKA	REGION		
Basin	Level	-	**GULF**	**OF**	**ALASKA**			
Play	**Level**	**-**	**Play**		**6**	**Subducting Terrane**		
Geologist	Larson,	Comer						
Remarks	Play	6	Subducting	Terrane	Kayak	Island	Zone	
Run Date & Time:		Date	19-Sep-05	Time	14:03:44			

Summary of Play Potential

Product	MEAN	Standard Deviation
BOE (Mboe)	133,730	238,760
Oil (Mbo)	64,427	111,210
Condensate (Mbc)	13,203	27,365
Free (Gas Cap & Nonassociated) Gas (Mmcfg)	249,640	526,320
Solution Gas (Mmcfg)	65,675	115,790

10000 (Number of Trials in Sample)

0.7418 (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	15,602	7,907	1,423	27,222	8,031
65	28,914	14,467	2,723	51,668	14,221
60	41,750	20,960	3,833	73,708	21,592
55	54,044	25,832	5,416	102,690	25,425
50	68,533	34,485	6,290	120,630	35,376
45	84,153	43,038	7,507	144,190	44,685
40	100,940	49,474	9,708	184,360	50,315
35	121,200	60,049	11,612	217,260	61,122
30	143,800	70,676	13,584	261,000	73,591
25	170,650	82,344	16,947	315,980	85,057
20	203,510	96,503	20,443	389,950	96,560
15	246,810	120,580	23,881	453,940	121,300
10	321,320	156,530	31,490	592,950	156,180
8	365,280	177,650	35,782	670,650	182,760
6	430,540	204,300	42,456	807,270	225,580
5	472,770	230,960	46,390	864,890	233,380
4	527,830	255,190	51,540	976,220	266,380
2	748,480	358,270	75,433	1,408,000	361,050
1	1,060,100	507,930	107,040	1,983,400	518,180
0.1	2,630,700	1,488,900	179,640	3,560,900	1,846,600
0.01	7,128,100	2,068,400	1,033,800	21,316,000	1,308,900
0.001	7,158,800	2,083,700	1,036,800	21,374,000	1,321,900

Table 5. Assessment results by commodity for Gulf of Alaska play 6, 2006 assessment.

Basin: GULF OF ALASKA
Play 06 - Subducting Terrane
UAI Key: AAAAAEAH

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	3	0.00958	0.0003	0.000404		3	0	0	1	1	0	0	0	0	1	1		0.052738	0.061284	0.171022	57.007279
2	0.0625	0.125	19	0.060674	0.0019	0.002561		19	0	0	1	1	0	0	0	0	1	1		0.082328	0.124611	2.056686	108.246610
3	0.125	0.25	58	0.185215	0.0058	0.007818		58	0	0	1	1	0	0	0	0	1	1		0.126805	0.247105	11.739024	202.396959
4	0.25	0.5	233	0.744052	0.0233	0.031406		233	0	0	1	2	0	0	0	0	1	2		0.251013	0.499953	91.055053	390.794218
5	0.5	1	636	2.030976	0.0636	0.085726		636	0	0	1	3	0	0	0	0	1	3		0.501348	0.997235	481.498340	757.072866
6	1	2	1636	5.224333	0.1636	0.220515		1636	0	0	1	4	0	0	0	0	1	4		1.000266	1.998327	2447.848000	1.496239
7	2	4	3042	9.714194	0.3042	0.410028		3042	0	0	1	4	0	0	0	0	1	4		2.000111	3.999595	9055.245000	2.976741
8	4	8	4837	15.446272	0.4837	0.651975		4837	0	0	1	5	0	0	0	0	1	5		4.001744	7.999121	28314.623000	5.853757
9	8	16	5994	19.140987	0.5994	0.807926		5994	0	0	1	6	0	0	0	0	1	6		8.000976	15.999385	69889.653000	11.659935
10	16	32	5597	17.873224	0.5597	0.754414		5597	0	0	1	5	0	0	0	0	1	5		16.000564	31.999772	128199.484000	22.905035
11	32	64	4534	14.478684	0.4534	0.611134		4534	0	0	1	5	0	0	0	0	1	5		32.002795	63.976155	203707.039000	44.928768
12	64	128	2658	8.487945	0.2658	0.358269		2658	0	0	1	4	0	0	0	0	1	4		64.000873	127.940439	238316.325000	89.660019
13	128	256	1289	4.116238	0.1289	0.173743		1289	0	0	1	3	0	0	0	0	1	3		128.053384	255.871334	224736.206000	174.349274
14	256	512	534	1.705253	0.0534	0.071977		534	0	0	1	3	0	0	0	0	1	3		256.080547	509.105894	186537.519000	349.321198
15	512	1024	182	0.581191	0.0182	0.024532		182	0	0	1	2	0	0	0	0	1	2		512.956969	1021.084000	129122.241000	709.462891
16	1024	2048	44	0.140508	0.0044	0.005931		44	0	0	1	1	0	0	0	0	1	1		1026.645000	1957.957000	60387.127000	1.372435
17	2048	4096	17	0.054287	0.0017	0.002291		17	0	0	1	1	0	0	0	0	1	1		2060.048000	3385.027000	41805.785000	2.459164
18	4096	8192	2	0.006387	0.0002	0.00027		2	0	0	1	1	0	0	0	0	1	1		7120.210000	7120.210000	14240.420000	7.120210
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	0.000000	0.000000	0.000000	0.000000
		Totals	**31315**	**100.000015**	**3.1315**	**4.220919**	Above Class	0	0	0									Above Class	0.000000	0.000000	0.000000	0.000000

Number of Pools not Classified: 0
Number of Pools below Class 1: 0
Number of Trials with Pools: 7419

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.

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

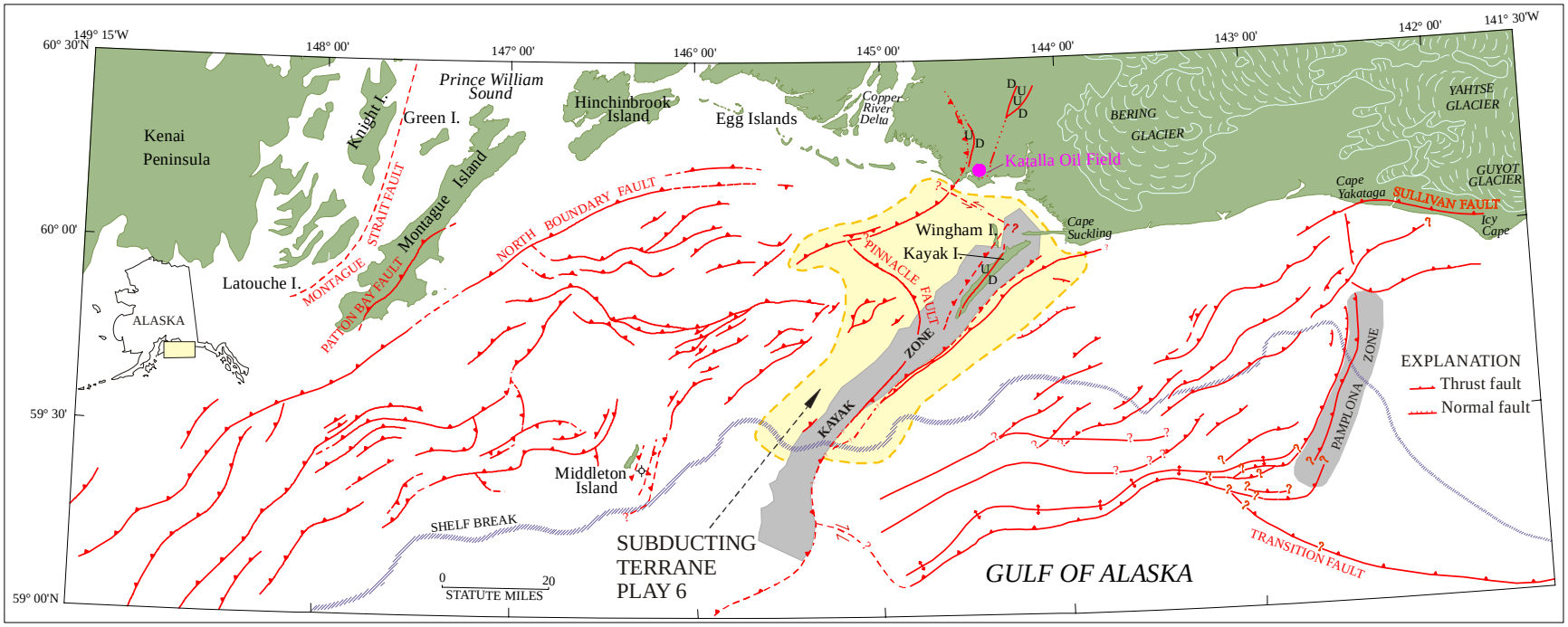

Figure 1. Map location of Gulf of Alaska play 6, 2006 assessment.