Beaufort Sea Play 8: Brookian Faulted Western Topset

Geological Assessment:
GRASP UAI: AAAAABAM
Play Area: 1905 square miles
Play Water Depth Range: 100 – 1600 feet
Play Depth Range: 2000 – 10000 feet
Play Exploration Chance: 0.2560

Play 8, Brookian Faulted Western Topset, Beaufort Sea 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	614	2,234
Total Gas (Tcfg)	0.000	2.090	7.027
Total Liquids (Mmbo)	0	242	983
Free Gas** (Tcfg)	0.000	2.056	6.883
Solution Gas (Tcfg)	0.000	0.034	0.144
Oil (Mmbo)	0	152	672
Condensate (Mmbc)	0	90	312

* 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 8, the "Brookian Faulted Western Topset" play, contains just under 5% of the Beaufort Province resource endowment (614 Mmbo mean BOE). The overall assessment results for play 8 are shown in table 1. Sixty percent of the resources are natural gas and one-third of the liquid resources are condensate. Table 5 reports the detailed assessment results by commodity for play 8.

Table 3 summarizes the volumetric input data developed for the _GRASP_ computer model of Beaufort Sea play 8. Table 4 reports the risk model used for play 8. The location of play 8 is shown in figure 1.

Play 8 includes Cretaceous deltaic-topset facies of the Nanushuk and Colville Groups extending northward from the hinge line fault zone to the province boundary. Reservoir quality is likely to be poor due to the distance from the sediment source and the high clay content of sandstones associated with distal parts of this mud-rich delta system. Sandstones may thicken abruptly in downthrown fault blocks. Source rocks are primarily gas-prone shales of the underlying Torok Formation and Colville Group. Rotated blocks along listric growth faults are the chief trapping mechanisms. No prospects have been tested in the play area.

The highest risk element for this play is the presence of reservoir facies. The presence of source, seal and adequate migration routes from source to reservoir are also risk factors.

A maximum of 23 hypothetical pools is forecast by the aggregation of the risk model and the prospect numbers model for play 8. These pools range in mean conditional (un-risked) recoverable volumes from 1.2 Mmboe (pool rank 23) to 542 Mmboe (pool rank 1). Pool rank 1 ranges in possible conditional recoverable volumes from 34 Mmboe (F95) to 2164 Mmboe (F05). Table 2 shows the conditional sizes of the 10 largest pools in play 8.

Play 8, Brookian Faulted Western Topset, Beaufort Sea 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	34	542	2164
2	12	150	477
3	5	69	214
4	3	38	119
5	1.6	24	76
6	1.1	17	52
7	0.8	12	38
8	0.6	9	29
9	0.5	7	23
10	0.4	6	19

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

Table 6 reports statistics for the simulation pools developed in the *GRASP* computer model for play 8. In the computer simulation for the play, a total of 55,220 "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 (8,745, or 16%) of simulation pools (conditional, technically recoverable BOE resources) for play 8. Pool size class 10 ranges from 16 to 32 Mmboe. The largest pool among the 55,220 simulation pools falls within pool size class 18, which ranges in size from 4,096 to 8,192 Mmboe.

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

Basin: Beaufort   **Assessor**: Johnson/Scherr   **Date**: 10/13/2005
Play Number: 08   **Play Name**: Brookian Faulted Western Topset
Play UAI Number: AAAAABAM

Play Area: mi^2 (million acres)   1905 (1218.9)   **Play Depth Range**: feet   2000   4,400   10000
Reservoir Thermal Maturity: % Ro   **Expected Oil Gravity**: ^{O} API   25
Play Water Depth Range: feet   100   200   1600

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	18	315		1191	3000		7558			28556		72635	80000
Prospect Area (acres)-Model Output													
Fill Fraction (Fraction of Area Filled)	0.1	0.144		0.289	0.499		0.756			0.949		0.99	1
Productive Area of Pool (acres)	3	112	200	514	1473	5270.7/11487.850	4374	7884	11983	18967			79641
Pay Thickness (feet)	13	36	43	57	80	90.591/ 48.523	112	133	150	180	220	252	500

MPRO Module (Numbers of Pools)

Play Level Chance	0.8	Prospect Level Chance	0.32	Exploration Chance	0.256

Risk Model	Play Chance	Petroleum System Factors			Prospect Chance
	0.8	Adequate Source			
		Adequate Seal			0.8
		Adequate Migration			0.8
		Presence of Reservoir Facies			0.5

Fractile	F99	F95	F90	F75	F50	Mean/Std. Dev.	F25	F15	F10	F05	F02	F01	F00
Numbers of Prospects in Play	12.00	14.00	15.30	17.50	20.50	21.58/4.95	24.00	26.00	27.50	30.20	33.50	35.90	36.00
Numbers of Pools in Play			0@F79.93	3	6	5.52/3.66	8	9	10	11	13	17	23

Minimum Number of Pools	0	Mean Number of Pools	5.52	Maximum Number of Pools	23

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)	115.0	219.8	246.1	297.4	367.0	385.592/125.175	452.9	507.0	547.3	612.9	696.2	758.0	1171.0
Gas Recovery Factor (Mcfg/acre-foot)	178	424	494	637	845	924.46/412.920	1121	1305	1446	1685	2000	2242	4019
Gas Oil Ratio (Sol'n Gas)(cf/bbl)	38.0	96.0	112.9	148.0	200.0	221.428/105.929	270.2	317.6	354.3	416.6	500.0	564.7	1051.0
Condensate Yield ((bbl/Mmcfg)	7.60	19.21	22.58	29.61	40.00	44.286/ 21.197	54.04	63.51	70.85	83.31	99.98	112.90	210.20

Pool Size Distribution Statistics from *POOLS* (1,000 BOE):	μ (mu)= 10.1363655 σ^2 (sigma squared)= 3.12923207	Random Number Generator Seed= 404060

BOE Conversion Factor (cf/bbl)	5620	Probability Any Pool Contains Both Oil and Free Gas (Gas Cap)	0.2
Probability Any Pool is 100% Oil	0	Fraction of Pool Volume Gas-Bearing in Oil Pools with Gas Cap	0.25
Probability Any Pool is 100% Gas	0.8		

Table 3. Input data for Beaufort Sea play 8, 2006 assessment.

Risk Analysis Form - 2006 National Assessment

Assessment Province: Beaufort	**Play Number, Name:** 08, Brookian Faulted Western Topset
Assessor(s): Johnson/Scherr	**Play UAI:** AAAAABAM
Date: 20-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**	*0.8000*	*0.8000*
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	0.80	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	0.80
c. Preservation				
Probability of effective retention of hydrocarbons in the prospects after accumulation.		1c	1.00	1.00
2. Reservoir component (2a * 2b)		**2**	*1.0000*	*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	1.00	0.50
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	1.00
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	1.00
b. Effective seal mechanism				
Probability of effective seal mechanism for the trap.		3b	1.00	0.80

Overall Play Chance (Marginal Probability of hydrocarbons, MPhc)	*0.8000*	
(1 * 2 * 3) *Product of All Subjective Play Chance Factors*		

Average Conditional Prospect Chance[1]		*0.3200*
(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	*0.2560*
(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 Beaufort Sea play 8, 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: AAAAABAM			**Play No.**			**8**	
World	Level	-	World	Level		Resources	
Country	Level	-	UNITED	STATES		OF	AMERICA
Region	Level	-	MMS	-		ALASKA	REGION
Basin	Level	-	**BEAUFORT**	**SHELF**			
Play	**Level**	**-**	**Play**			**8 Brookian Faulted Western Topset**	
Geologist	Peter	Johnson					
Remarks	Play	8	2005	Assessment			
Run Date & Time:		Date	19-Sep-05	Time		13:48:48	

Summary of Play Potential

Product	MEAN	Standard Deviation
BOE (Mboe)	613,780	819,860
Oil (Mbo)	151,890	398,390
Condensate (Mbc)	90,058	136,750
Free (Gas Cap & Nonassociated) Gas (Mmcfg)	2,055,800	2,905,000
Solution Gas (Mmcfg)	33,884	99,908

    10000 (Number of Trials in Sample)
     0.799 (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	3,069	344	505	12,405	69
75	76,945	13,118	12,421	285,980	2,926
70	134,240	27,612	21,706	471,650	5,631
65	181,700	27,746	29,902	689,790	7,359
60	237,880	47,322	36,011	857,850	10,694
55	290,600	54,960	44,387	1,062,200	12,642
50	347,720	70,522	53,016	1,244,300	15,562
45	413,120	82,334	64,539	1,481,200	15,158
40	487,440	115,710	69,538	1,670,100	28,224
35	573,870	103,860	91,896	2,100,100	24,933
30	674,530	141,170	104,980	2,377,100	30,385
25	803,990	155,480	120,740	2,929,200	36,848
20	973,180	188,940	162,370	3,453,600	41,268
15	1,195,100	206,820	193,790	4,418,200	46,695
10	1,551,700	370,310	223,550	5,298,200	85,061
8	1,773,100	347,250	276,650	6,385,400	73,234
6	2,047,800	533,670	297,850	6,726,200	109,300
5	2,233,800	671,880	311,500	6,882,900	144,350
4	2,451,900	686,170	345,410	7,823,700	158,580
2	3,215,200	832,220	477,380	10,517,000	192,970
1	3,974,700	1,164,900	568,780	12,331,000	263,540
0.1	6,283,400	14,902	1,375,000	27,500,000	1,907
0.01	8,196,000	0	1,548,900	37,357,000	0
0.001	9,204,900	4,024,200	647,760	24,618,000	856,700

Table 5. Assessment results by commodity for Beaufort Sea play 8, 2006 assessment.

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	44	0.079681	0.0044	0.005506	1	0	43	1	1	0	0	1	1	1	1	0.034033	0.062444	2.171050	49.342051
2	0.0625	0.125	116	0.210069	0.0116	0.014516	13	0	103	1	1	0	0	1	1	1	1	0.062553	0.122804	10.545387	90.908513
3	0.125	0.25	217	0.392974	0.0217	0.027156	22	0	195	1	1	0	0	1	2	1	2	0.125452	0.249843	40.504939	186.658710
4	0.25	0.5	452	0.818544	0.0452	0.056564	55	0	397	1	1	0	0	1	2	1	2	0.250083	0.498365	166.827218	369.086772
5	0.5	1	1018	1.843535	0.1018	0.127393	134	0	884	1	2	0	0	1	2	1	2	0.502488	0.998955	779.940764	766.150057
6	1	2	2100	3.80297	0.21	0.262796	238	0	1862	1	2	0	0	1	3	1	4	1.000440	1.998870	3167.811000	1.508481
7	2	4	3828	6.932271	0.3828	0.479039	474	0	3354	1	2	0	0	1	4	1	4	2.000049	3.997927	11381.547000	2.973236
8	4	8	6241	11.302065	0.6241	0.781004	937	0	5304	1	3	0	0	1	5	1	6	4.000020	7.999183	36650.462000	5.872530
9	8	16	7915	14.333575	0.7915	0.990489	1363	0	6552	1	3	0	0	1	6	1	7	8.001905	15.999836	92575.176000	11.696169
10	16	32	8745	15.836654	0.8745	1.094356	1728	0	7017	1	4	0	0	1	6	1	7	16.000450	31.996216	200785.783000	22.960066
11	32	64	8134	14.73017	0.8134	1.017895	1859	0	6275	1	4	0	0	1	6	1	6	32.005219	63.992210	375398.267000	46.151741
12	64	128	6515	11.798262	0.6515	0.815292	1548	0	4967	1	4	0	0	1	5	1	6	64.001026	127.955171	594013.861000	91.176338
13	128	256	4658	8.435349	0.4658	0.582906	1258	0	3400	1	3	0	0	1	5	1	5	128.040787	255.878655	841412.932000	180.638245
14	256	512	2665	4.82615	0.2665	0.3335	786	0	1879	1	3	0	0	1	4	1	4	256.043211	511.816160	946627.943000	355.207489
15	512	1024	1504	2.723651	0.1504	0.188212	419	0	1085	1	2	0	0	1	3	1	3	512.014928	1023.307000	1083822.000000	720.626465
16	1024	2048	772	1.398044	0.0772	0.096609	256	0	516	1	2	0	0	1	2	1	3	1024.103000	2043.367000	1107566.000000	1.434671
17	2048	4096	247	0.447302	0.0247	0.03091	97	0	150	1	2	0	0	1	2	1	2	2052.117000	4066.273000	678879.638000	2.748500
18	4096	8192	30	0.054328	0.003	0.003754	18	0	12	1	1	0	0	1	1	1	1	4112.058000	6941.958000	164558.309000	5.485277
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			19	0.034408	0.0019	0.002378	**Below Class** 0	0	19									**Below Class** 0.017778	0.030060	0.461561	24.292696
	Totals		55220	100	5.522	6.910274	**Above Class** 0	0	0									**Above Class** 0.000000	0.000000	0.000000	0.000000

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 not Classified: 19
Number of Pools below Class 1: 19
Number of Trials with Pools: 7991

Table 6. Statistics for simulation pools created in computer sampling run for Beaufort Sea play 8, 2006 assessment.
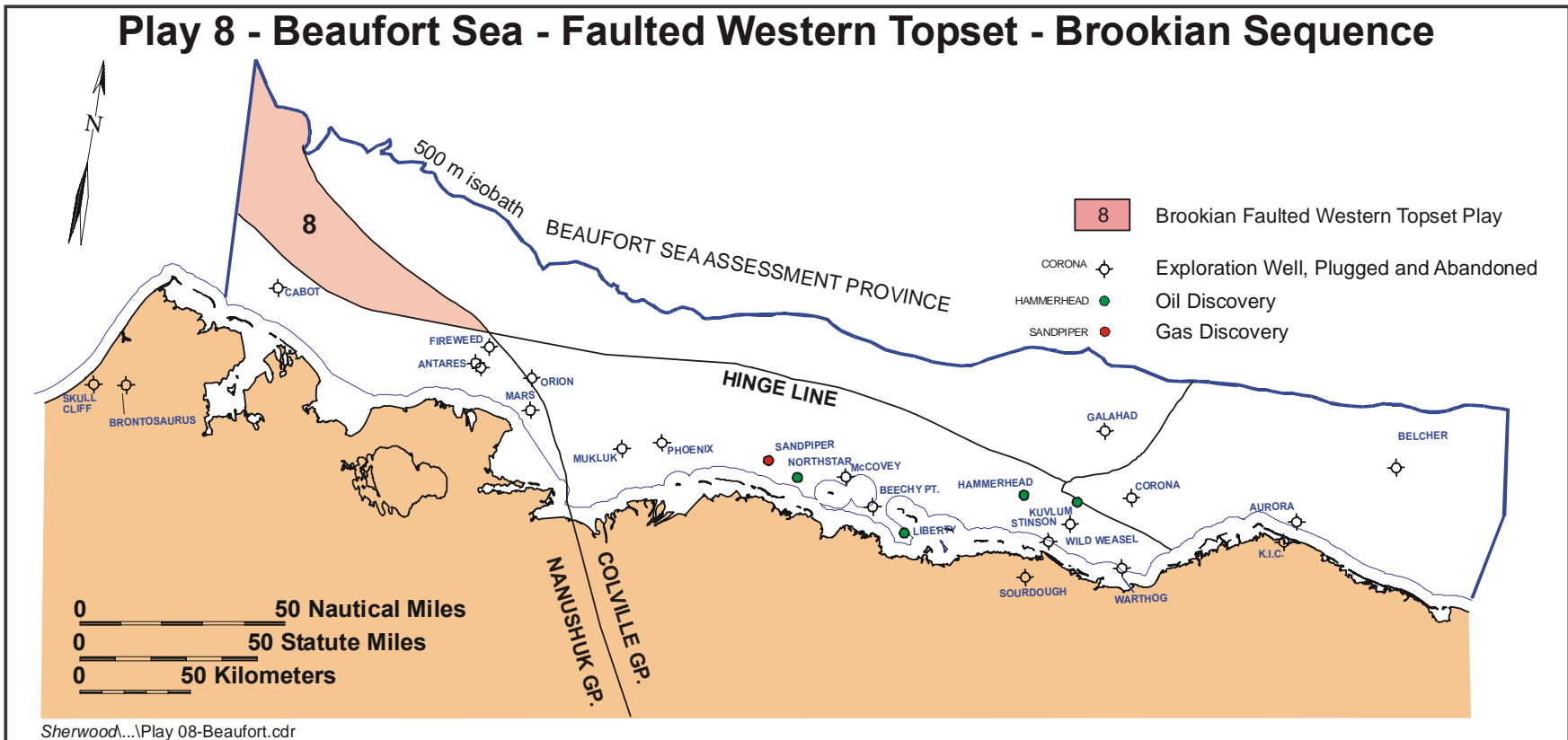
Figure 1. Map location of Beaufort Sea play 8, 2006 assessment.