Beaufort Sea Play 10: Brookian Faulted Western Turbidites

Geological Assessment:

GRASP UAI: AAAAABAQ
Play Area: 3,814 square miles
Play Water Depth Range: 100 – 1600 feet
Play Depth Range: 3000 – 23000 feet
Play Exploration Chance: 0.324

Play 10, Brookian Faulted Western Turbidite, 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	232	815
Total Gas (Tcfg)	0.000	0.967	3.457
Total Liquids (Mmbo)	0	60	200
Free Gas** (Tcfg)	0.000	0.955	3.415
Solution Gas (Tcfg)	0.000	0.012	0.042
Oil (Mmbo)	0	17	48
Condensate (Mmbc)	0	42	151

** 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 10, the "Brookian Faulted Western Turbidite" play, contains less than 2% of the Beaufort Sea Province resource endowment (232 Mmbo mean BOE). The overall assessment results for play 10 are shown in Table 1. Seventy-four percent of the endowment is from natural gas. Table 5 reports the detailed assessment results by commodity for play 10.

Table 3 summarizes the volumetric input data developed for the GRASP computer model of Beaufort Sea play 10. Table 4 reports the risk model used for play 10. The location of play 10 is shown in figure 1.

Play 10 includes the Cretaceous prodelta facies of the Brookian deltas—the Torok Formation and lower Colville Group. Expected reservoirs include lowstand wedge sandstones or submarine fan turbidite sandstones. Sandstone sequences may thicken abruptly in down-thrown blocks along the hinge line fault zone. Sandstones are likely to offer only poor reservoir quality due to the fine-grained and mud-rich nature of the sediments fed to the shelf break by the Nanushuk delta system. Shales in the Torok Formation and Colville Group are primarily gas sources due to kerogen content and because many thousands of feet of the shales have passed through the oil window and into the gas window. Traps in the play are expected to be primarily stratigraphically controlled. There is also potential for fault traps against hinge-line listric growth faults. No prospects have been tested in the play area.

The primary risk factor in this play is the presence of a quality reservoir. Presence of seal and adequate source are also risk factors.

A maximum of 15 hypothetical pools is forecast by the aggregation of the risk model and the prospect numbers model for play 10. These pools range in mean conditional (un-risked) recoverable volumes from 2.5 Mmboe (pool rank 15) to 205 Mmboe (pool

rank 1). Pool rank 1 ranges in possible conditional recoverable volumes from 17 Mmboe (F95) to 676 Mmboe (F05). Table 2 shows the conditional sizes of the 10 largest pools in play 10.

Play 10, Brookian Faulted Western Turbidites, 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	17	205	676
2	6	60	189
3	3	30	87
4	1.87	19	53
5	1.27	13	37
6	0.97	10	28
7	0.77	8	22
8	0.64	7	18
9	0.55	6	15
10	0.47	5	13

** 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 10. In the computer simulation for the play, a total of 36,247 "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 (7,329 or 20%) of simulation pools (conditional, technically recoverable BOE resources) for play 10. Pool size class 10 ranges from 16 to 32 Mmboe. The largest pool among the 36,247 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**: 10/14/2005
Play Number: 10 | **Play Name**: Brookian Faulted Western Turbidite
Play UAI Number: AAAAABAQ

Play Area: mi² (million acres) 3814 (2441.2)
Reservoir Thermal Maturity: % Ro

Play Depth Range: feet	3000	12,000	23000
Expected Oil Gravity: ° API	25		
Play Water Depth Range: feet	100	500	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	163	1099		2683	4990		9280			22655		42404	60000
Prospect Area (acres)-Model Output													
Fill Fraction (Fraction of Area Filled)	0.1	0.14		0.29	0.5		0.76			0.95		0.99	1
Productive Area of Pool (acres)	21	341	525	1073	2391	5033.975/8478.150	5160	7688	10384	15207			58902
Pay Thickness (feet)	7.0	21.9	26.6	36.9	53.0	61.486/36.492	76.2	92.6	105.6	128.4	160.0	185.3	392.0

MPRO Module (Numbers of Pools)

Play Level Chance	0.8	**Prospect Level Chance**	0.405	**Exploration Chance**	0.324

Risk Model	Play Chance	Petroleum System Factors	Prospect Chance
	0.8	Adequate Source	
		Adequate Seal	0.9
		Presence of Reservoir Facies	0.45

Fractile	F99	F95	F90	F75	F50	Mean/Std. Dev.	F25	F15	F10	F05	F02	F01	F00
Numbers of Prospects in Play	6.00	7.05	7.70	8.90	10.40	11.19/2.53	12.15	13.35	14.10	15.30	16.80	17.90	18.00
Numbers of Pools in Play			0@F79.52	2	4	3.63/ 2.51	5	6	7	8	9	9	15

Minimum Number of Pools	0	**Mean Number of Pools**	3.63	**Maximum Number of Pools**	15

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)	42.0	97.5	113.0	144.5	190.0	206.636/88.921	249.8	289.2	319.5	370.2	436.9	488.0	858.0
Gas Recovery Factor (Mcfg/acre-foot)	128.0	363.5	436.2	591.6	830.0	944.41/ 516.946	1164.4	1396.4	1579.2	1895.1	2326.8	2668.0	5368.0
Gas Oil Ratio (Sol'n Gas)(cf/bbl)	68	229	283	404	600	715.843/470.258	891	1102	1272	1574	2000	2347	5309
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)= 10.0535854 σ^2 (sigma squared)= 2.06969277 | **Random Number Generator Seed=** 495401

BOE Conversion Factor (cf/bbl)	5620	**Probability Any Pool Contains Both Oil and Free Gas (Gas Cap)**	0.1
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	0.9		

Table 3. Input data for Beaufort Sea play 10, 2006 assessment.

Risk Analysis Form - 2006 National Assessment

Assessment Province:	Beaufort	**Play Number, Name:**	10, Brookian Faulted Western Turbidite
Assessor(s):	Johnson/Scherr	**Play UAI:**	AAAAABAQ
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***	***1.0000***
	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. 0.8			
	Probability of effective expulsion and migration of hydrocarbons from the source rock to the reservoirs.	1b	1.00	1.00
	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***	***0.4500***
	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	0.45
	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***	***0.9000***
	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	0.90
	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]			***0.4050***
	(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		***0.3240***	
	(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 10, 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:	**AAAAABAQ**		**Play No.**		**10**		
World	Level	-	World	Level		Resources	
Country	Level	-	UNITED	STATES		OF	AMERICA
Region	Level	-	MMS	-		ALASKA	REGION
Basin	Level	-	**BEAUFORT**	**SHELF**			
Play	**Level**	**-**	**Play**		**10**	**Brookian**	**Faulted**
Geologist	Peter	Johnson				**Western**	**Turbidite**
Remarks	Play	10	2005	Assessment			
Run Date & Time:		Date	19-Sep-05	Time	13:49:09		

Summary of Play Potential

Product	MEAN	Standard Deviation
BOE (Mboe)	231,810	323,420
Oil (Mbo)	17,339	69,288
Condensate (Mbc)	42,399	70,531
Free (Gas Cap & Nonassociated) Gas (Mmcfg)	954,770	1,357,800
Solution Gas (Mmcfg)	12,243	53,209

10000 (Number of Trials in Sample)
0.795 (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	4	0	1	16	0
75	28,975	2,706	4,900	118,440	1,663
70	52,566	4,963	9,219	212,190	3,531
65	72,984	3,659	13,581	311,000	2,276
60	94,167	8,625	16,319	383,130	5,909
55	113,010	9,068	20,316	464,230	5,748
50	134,240	6,916	24,583	572,170	5,218
45	158,560	12,619	27,616	657,380	7,617
40	185,690	11,885	33,663	780,160	7,410
35	216,410	14,042	40,341	901,180	9,397
30	254,330	19,647	44,690	1,054,800	12,953
25	299,850	21,835	51,794	1,259,400	12,018
20	358,520	25,905	66,001	1,478,200	20,202
15	439,070	36,219	81,181	1,775,300	32,453
10	565,650	49,863	105,620	2,257,200	47,950
8	648,430	55,561	112,310	2,653,100	47,589
6	740,620	39,050	137,410	3,146,100	24,521
5	814,970	48,454	151,430	3,415,000	41,778
4	906,560	49,255	173,880	3,805,100	35,744
2	1,218,800	98,106	213,900	5,023,200	72,748
1	1,571,400	147,610	291,200	6,273,600	91,455
0.1	2,977,400	1,830,700	105,850	4,567,000	1,282,700
0.01	3,423,600	24,164	432,040	16,672,000	4,658
0.001	6,138,700	23,558	2,548,600	20,033,000	10,783

Table 5. Assessment results by commodity for Beaufort Sea play 10, 2006 assessment.

Basin: BEAUFORT SHELF
Play 10 - Brookian Faulted Western Turbidite
UAI Key: AAAAABAQ

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	2	0.005518	0.0002	0.000252		0	0	2	0	0	0	0	1	1	1	1	0.048024	0.058065	0.106089	53.044580
2	0.0625	0.125	15	0.041383	0.0015	0.001887		2	0	13	1	1	0	0	1	1	1	1	0.066193	0.117801	1.482232	98.815478
3	0.125	0.25	90	0.248296	0.009	0.011319		10	0	80	1	1	0	0	1	1	1	1	0.125781	0.246631	17.359325	192.881390
4	0.25	0.5	168	0.463487	0.0168	0.021129		9	0	159	1	1	0	0	1	2	1	2	0.254440	0.499523	63.808770	379.814118
5	0.5	1	386	1.064916	0.0386	0.048547		35	0	351	1	1	0	0	1	2	1	2	0.501338	0.999474	290.816247	753.409982
6	1	2	900	2.482964	0.09	0.113193		67	0	833	1	1	0	0	1	2	1	2	1.004084	1.997581	1358.249000	1.509165
7	2	4	2157	5.950837	0.2157	0.271287		160	0	1997	1	1	0	0	1	4	1	4	2.000379	3.999962	6513.901000	3.019889
8	4	8	4134	11.405082	0.4134	0.519935		387	0	3747	1	2	0	0	1	5	1	5	4.004017	7.998655	24611.689000	5.953481
9	8	16	6243	17.223494	0.6243	0.785184		574	0	5669	1	3	0	0	1	5	1	5	8.000410	15.998358	73251.375000	11.733361
10	16	32	7329	20.219604	0.7329	0.921771		803	0	6526	1	3	0	0	1	6	1	6	16.002457	31.997822	169309.884000	23.101362
11	32	64	6392	17.634563	0.6392	0.803924		740	0	5652	1	3	0	0	1	7	1	7	32.003558	63.993112	290925.297000	45.513969
12	64	128	4402	12.144453	0.4402	0.553641		494	0	3908	1	2	0	0	1	5	1	5	64.009795	127.892698	392916.998000	89.258743
13	128	256	2299	6.342594	0.2299	0.289146		260	0	2039	1	2	0	0	1	4	1	4	128.022386	255.762695	408994.474000	177.901031
14	256	512	1108	3.056805	0.1108	0.139354		104	0	1004	1	1	0	0	1	3	1	3	256.135217	511.949938	389608.250000	351.631989
15	512	1024	468	1.291141	0.0468	0.058861		64	0	404	1	1	0	0	1	2	1	2	513.309450	1013.691000	324655.847000	693.709045
16	1024	2048	128	0.353133	0.0128	0.016099		13	0	115	1	1	0	0	1	1	1	1	1024.138000	2013.093000	170234.124000	1.329954
17	2048	4096	25	0.068971	0.0025	0.003144		2	0	23	1	1	0	0	1	1	1	1	2072.895000	2776.622000	59362.046000	2.374482
18	4096	8192	1	0.002759	0.0001	0.000126		0	0	1	0	0	0	0	1	1	1	1	5935.836000	5935.836000	5935.836000	5.935836
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									0.000000	0.000000	0.000000	0.000000
		Totals	**36247**	**100**	**3.6247**	**4.558797**	Above Class	0	0	0									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: 0
Number of Pools below Class 1: 0
Number of Trials with Pools: 7951

Table 6. Statistics for simulation pools created in computer sampling run for Beaufort Sea play 10, 2006 assessment.

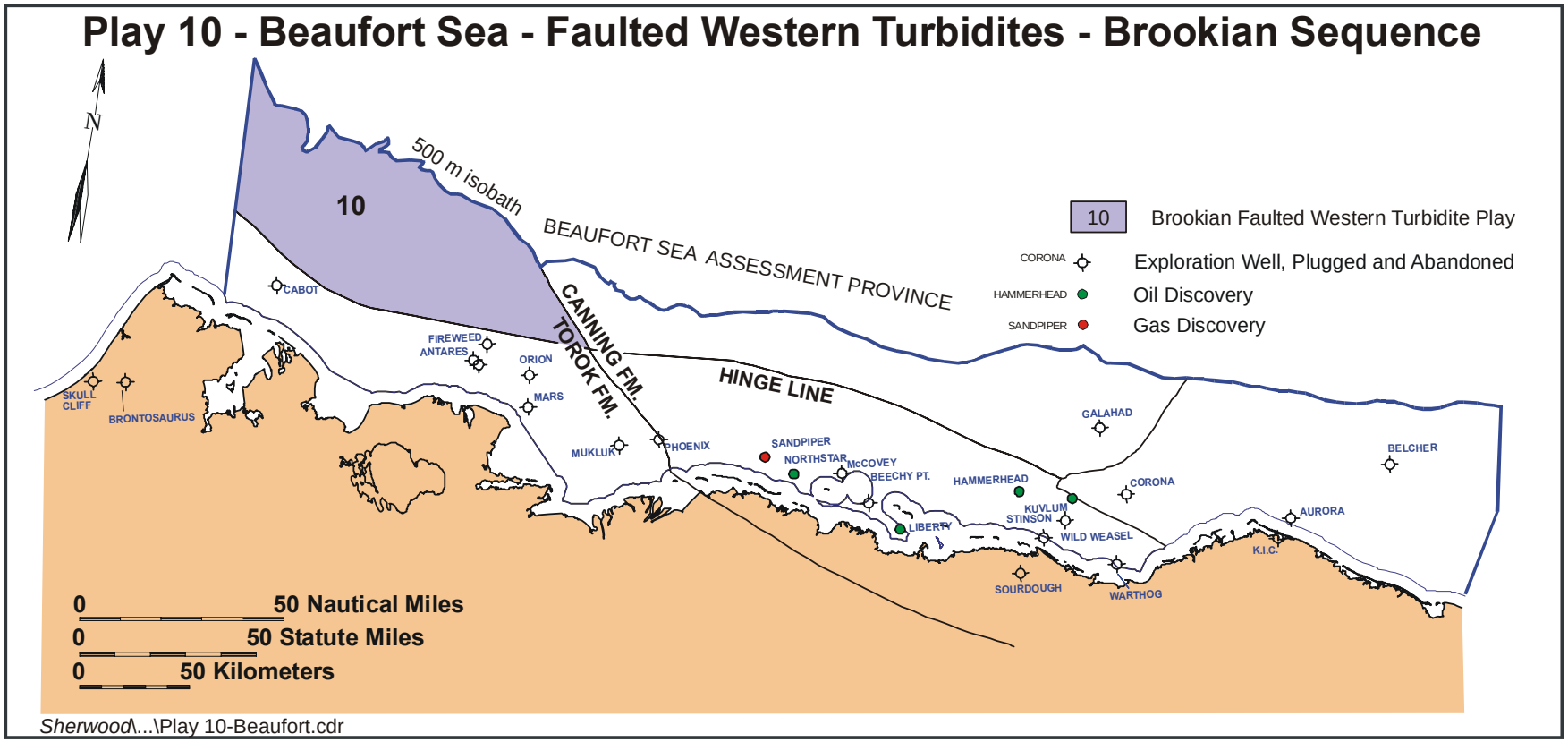

Figure 1. Map location of Beaufort Sea play 10, 2006 assessment.