

Chukchi Sea Play 24: Lower Brookian—Nuwuk Basin

Geological Assessment

GRASP UAI: AAAAA DAY

Play Area: 3,238 square miles

Play Water Depth Range: 130-1,500 feet

Play Depth Range: 2,500-25,000 feet

Play Exploration Chance: 0.0918

Play 24, Lower Brookian-Nuwuk Basin, Chukchi 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	568	2,245
Total Gas (Tcfg)	0.000	1.904	7.545
Total Liquids (Mmbo)	0	230	902
Free Gas** (Tcfg)	0.000	1.661	6.581
Solution Gas (Tcfg)	0.000	0.243	0.964
Oil (Mmbo)	0	139	554
Condensate (Mmbc)	0	90	349
<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 24, the “Lower Brookian—Nuwuk Basin” play, is the 10th-ranking play (of 29 plays) in the Chukchi Sea OCS Planning Area, with 2% (568 Mmboe) of the Planning Area energy endowment (29,041 Mmboe). The overall assessment results for play 24 are shown in [table 1](#). Oil and gas-condensate liquids form 40% of the hydrocarbon energy endowment of play 24.

[Table 5](#) reports the detailed assessment results by commodity for play 24.

[Table 3](#) summarizes the volumetric input data developed for the *GRASP* model for Chukchi Sea play 24. [Table 4](#) reports the risk model used for play 24. The location of play 24 is shown in [figure 1](#).

Play 24 includes the Upper Cretaceous (?) rocks correlative to the Colville Group and Lower Cretaceous rocks correlative to the Torok Formation and Nanushuk Group. The entire sequence exceeds 30,000 feet and thickness and passes below conventional seismic records in the northern part of the play area. Expected reservoirs may include sandstones deposited in deltaic settings, in off-shelf lowstand wedges, or in submarine fan complexes filling channels and canyons and mounded at slope bases. Reservoir sequences may thicken abruptly in down-thrown blocks along listric growth faults which dissect Nuwuk basin. 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-Torok delta system. Only a reconnaissance seismic grid exists over most of the area of this play. For this reason, probability distributions for prospect areas and prospect numbers in this play are based on seismic mapping in a structurally-analogous area on the west flank of North Chukchi high. Ellesmerian rocks are not known to be present beneath Nuwuk basin. Therefore, source rocks for oil or gas would have to be associated with shales of the underlying Torok Formation-equivalent Lower Brookian sequence. Torok Formation shales are gas-prone where sampled in well bores onshore. In Nuwuk

basin, many thousands of feet of these shales have passed through the oil window and into the gas window. Rotated blocks along listric growth faults are the main types of traps. No wells have penetrated the Nuwuk basin fill.

Play 24, Lower Brookian-Nuwuk Basin, Chukchi 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	101	508	1415
2	57	250	560
3	32	163	379
4	20	116	271
5	14	88	210
6	10	69	169
7	8	57	141
8	7	48	120
9	6.1	41	105
10	5.5	36	92
* 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 48 hypothetical pools is forecast by the aggregation of the risk model and the prospect numbers model for play 24. These 48 pools range in mean conditional (un-risked) recoverable volumes from 5 Mmboe (pool rank 48) to 508 Mmboe (pool rank 1). Pool rank 1 ranges in possible conditional recoverable volumes from 112 Mmboe (F95) to 1,415 Mmboe (F05). [Table 2](#) shows the conditional sizes of the 10 largest pools in play 24.

In the computer simulation for play 24 a total of 42,089 "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 12 contains the largest share (8,971, or 21%) of simulation pools (conditional, technically recoverable BOE resources) for play 24. Pool size class 12 ranges from 64 to 128 Mmboe. The largest 5 simulation pools for play 24 fall within pool size class 18, which ranges in size from 4,096 to 8,192 Mmboe. [Table 6](#) reports statistics for the simulation pools developed in the *GRASP* computer model for play 24.

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

Basin: Chukchi Sea Planning Area
Play Number: 24

Play UAI Number: AAAAA DAY

Assessor: K.W. Sherwood
Play Name: Lower Brookian - Nuwuk Basin

Date: January 2005

Play Area: mi² (million acres) 3,238 (2.072)
Reservoir Thermal Maturity: % Ro 0.30 - 2.00

Play Depth Range: feet 2,500 - 25,000 (mean = 12,000)
Expected Oil Gravity: ° API 35
Play Water Depth Range: feet 130 - 1,500 (mean = 300)

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*	450		1249		4643	7845/10686			17253				34444
Prospect Area (acres)-Model Output**	455	927	1269	2303	4620	6874/6498	9028	13011	15983	21222			34378
Fill Fraction (Fraction of Area Filled)	0.10	0.20	0.22	0.26	0.32	0.33/0.10	0.39	0.43	0.46	0.51			1.00
Productive Area of Pool (acres)***	100	276	393	714	1465	2289/2344	2967	4220	5386	7392	9000	10000	20326
Pay Thickness (feet)	35	84	95	118	150	160/58	190	216	236	268	310	341	600

* model fit to prospect area data 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	0.45
Output Play Level Chance*	0.4495

Prospect Level Chance	0.204
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Exploration Chance	0.0918
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* First Occurrence of Non Zero Pools As Reported in PSUM Module

Risk Model	Play Chance	Petroleum System Factors	Prospect Chance
		Closure Reliability (highly faulted)	0.6
		Seal Integrity (many down-side fault traps)	0.8
	0.45	Reservoir Presence (muddy, distal-turbidite facies)	
		Chance Porosity > 10%	0.85
		Migration (primarily vertical along faults with limited fetch; risk of diversion of hydrocarbons to surface or shallower traps)	0.5

Fractile	F99	F95	F90	F75	F50	Mean/Std. Dev.	F25	F15	F10	F05	F02	F01	F00
Numbers of Prospects in Play	20	25	28	35	42	45.76/16.14	53	60	64	73	82	90	160
Numbers of Pools in Play						4.20/5.46	8	11	12	14	17	19	48

Zero Pools at F44.97

Minimum Number of Pools	5 (F40)	Mean Number of Pools	4.2	Maximum Number of Pools	48
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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)	30	62	76	109	166	189/108	243	297	334	392	460	510	948
Gas Recovery Factor (Mcfg/acre-foot)	265	814	964	1298	1829	1975/885	2475	2886	3183	3629	3900	4200	6651
Gas Oil Ratio (Sol'n Gas)(cf/bbl)	480	1250	1350	1550	1750	1743/353	1950	2100	2150	2300	2400	2500	3000
Condensate Yield ((bbl/Mmcfg)	13	29	33	40	50	54/19	64	72	79	90	105	120	200

Pool Size Distribution Statistics from *POOLS* (1,000 BOE): μ (mu)= 11.132 σ^2 (sigma squared)= 1.503 Random Number Generator Seed= 010178

BOE Conversion Factor (cf/bbl)	5620	Probability Any Pool Contains Both Oil and Free Gas (Gas Cap)	0.23
Probability Any Pool is 100% Oil	0.34	Fraction of Pool Volume Gas-Bearing in Oil Pools with Gas Cap	0.5
Probability Any Pool is 100% Gas	0.43		

Table 3. Input data for Chukchi Sea play 24, 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: AAAAAADAY		Play No. 24	
World	Level -	World	Level
Country	Level -	UNITED STATES	Resources OF AMERICA
Region	Level -	MMS	ALASKA REGION
Basin	Level -	CHUKCHI SEA	SHELF
Play	Level -	Play	24 Lower Brookian - Nuwuk Basin
Geologist	Kirk W.	Sherwood	
Remarks	2005 Assessment		
Run Date & Time:	Date	19-Sep-05 Time	13:57:00

Summary of Play Potential

Product	MEAN	Standard Deviation
BOE (Mboe)	568,400	855,660
Oil (Mbo)	139,230	238,130
Condensate (Mbc)	90,377	157,080
Free (Gas Cap & Nonassociated) Gas (Mmcfg)	1,660,900	2,723,200
Solution Gas (Mmcfg)	243,120	420,110

10000 (Number of Trials in Sample)

0.4495 (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	28,764	8,634	4,015	76,516	14,050
40	419,070	114,500	62,871	1,160,000	198,380
35	613,520	168,360	86,242	1,729,300	287,850
30	799,090	204,750	121,710	2,296,100	360,090
25	988,840	260,340	152,800	2,783,400	452,030
20	1,184,000	317,050	177,330	3,335,300	540,500
15	1,433,400	334,790	225,100	4,317,100	591,920
10	1,743,100	428,850	279,300	5,072,100	744,260
8	1,906,000	477,270	298,860	5,503,700	846,290
6	2,105,900	508,570	332,120	6,223,700	886,910
5	2,245,000	553,910	348,520	6,581,300	963,990
4	2,396,500	546,390	404,730	7,167,600	955,480
2	2,938,900	630,440	489,770	9,102,900	1,118,100
1	3,538,400	700,190	638,510	11,151,000	1,211,500
0.1	5,828,600	1,637,200	954,100	15,603,000	2,590,800
0.01	7,977,500	1,130,500	1,416,300	28,313,000	2,207,200
0.001	8,768,800	679,020	3,150,600	26,453,000	1,305,900

Table 5. Assessment results by commodity for Chukchi Sea play 24, 2006 assessment.

Basin: CHUKCHI SEA SHELF Play 24 - L. Brookian - Nuwuk Basin UAI Key: AAAAADAY							Model Simulation "Pools" Reported by "Fieldsiz.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	0	0.000000	0.000000						
2	0.0625	0.125	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000						
3	0.125	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000						
4	0.25	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000						
5	0.5	1	10	0.023759	0.001	0.002224	0	9	1	0	0	1	1	1	1	1	1	1	1	0.731187	0.986761						
6	1	2	91	0.216209	0.0091	0.02024	7	66	18	1	1	1	1	1	1	1	1	1	1	1.095197	1.997425						
7	2	4	448	1.064411	0.0448	0.099644	56	290	102	1	2	1	2	1	2	1	2	1	3	2.029734	3.998245						
8	4	8	1431	3.399938	0.1431	0.318283	263	805	363	1	2	1	3	1	2	1	2	1	4	4.004169	7.997749						
9	8	16	3343	7.942693	0.3343	0.74355	654	1679	1010	1	4	1	5	1	3	1	3	1	7	8.006794	15.997517						
10	16	32	6094	14.478843	0.6094	1.355427	1388	2571	2135	1	4	1	7	1	5	1	5	1	10	16.004517	31.995367						
11	32	64	8363	19.869801	0.8363	1.860098	2117	3010	3236	1	5	1	8	1	6	1	6	1	12	32.009952	63.997207						
12	64	128	8971	21.314358	0.8971	1.995329	2221	2851	3899	1	7	1	5	1	8	1	8	1	16	64.000516	127.996677						
13	128	256	7455	17.712467	0.7455	1.658141	1855	1998	3602	1	5	1	4	1	6	1	6	1	11	128.013706	255.987097						
14	256	512	4089	9.715127	0.4089	0.909475	955	832	2302	1	4	1	3	1	5	1	5	1	7	256.159008	511.723809						
15	512	1024	1471	3.494975	0.1471	0.32718	289	255	927	1	2	1	3	1	4	1	4	1	4	512.005191	1022.473000						
16	1024	2048	286	0.679512	0.0286	0.063612	33	56	197	1	1	1	1	1	2	1	2	1	2	1026.554000	2027.447000						
17	2048	4096	32	0.076029	0.0032	0.007117	5	0	27	1	1	0	0	0	1	1	1	1	1	2050.393000	3699.290000						
18	4096	8192	5	0.01188	0.0005	0.001112	0	0	5	0	0	0	0	0	1	1	1	1	1	4231.967000	5634.120000						
19	8192	16384	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000						
20	16384	32768	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000						
21	32768	65536	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000						
22	65536	131072	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000						
23	131072	262144	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000						
24	262144	524288	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000						
25	524288	1048576	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000						
Not Classified			0	0	0	0	Below Class	0	0	0									Below Class	0.000000	0.000000						
Totals			42089	99.999992	4.2089	9.361432	Above Class	0	0	0									Above Class	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: 4496																											

Table 6. Statistics for simulation pools created in computer sampling run for Chukchi Sea play 24, 2006 assessment.

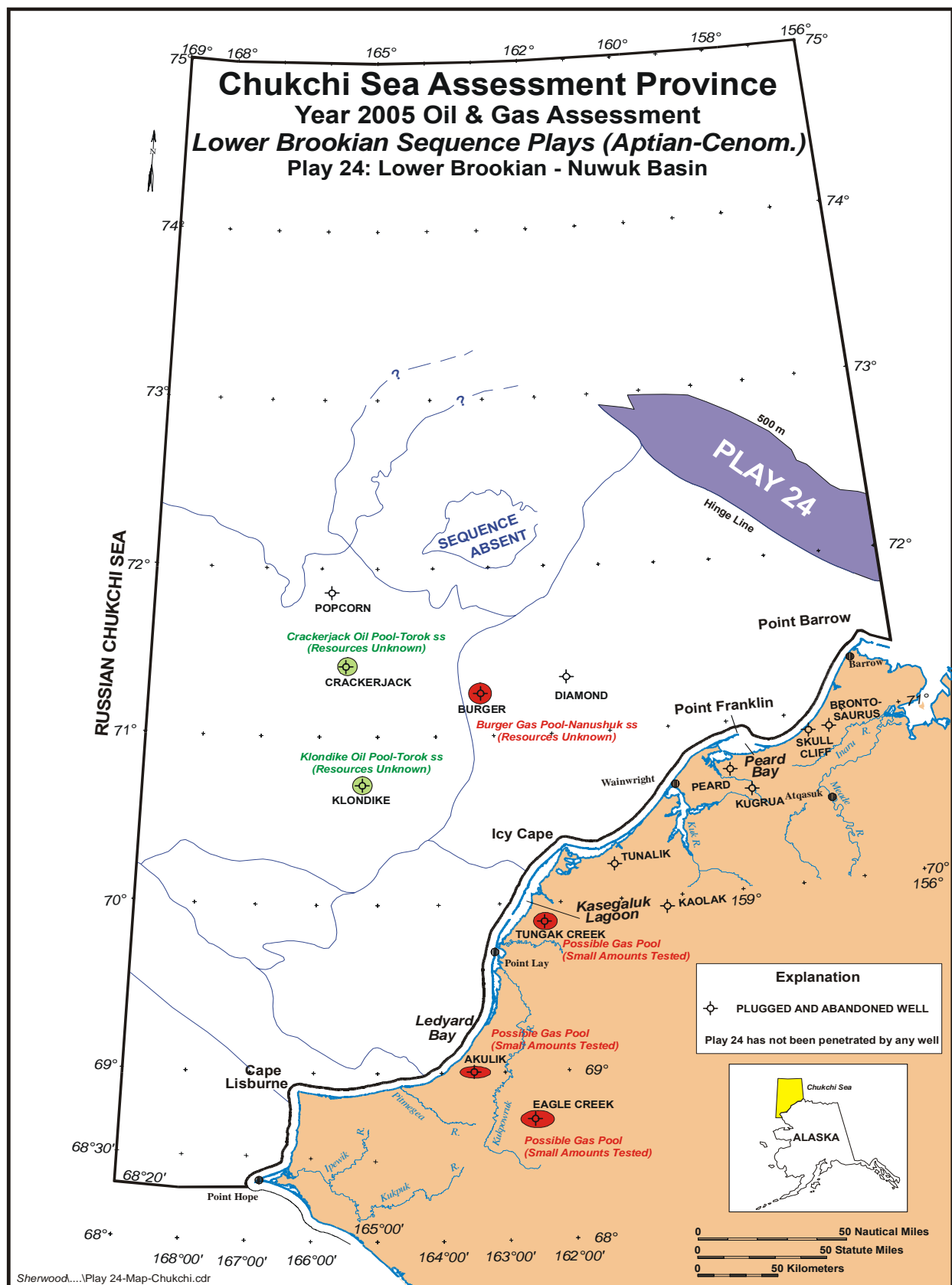


Figure 1. Map location of Chukchi Sea play 24, 2006 assessment.