

## Chukchi Sea Play 3: Lisburne Carbonates

### Geological Assessment

*GRASP UAI: AAAAA DAD*

*Play Area: 11,608 square miles*

*Play Water Depth Range: 90-170 feet*

*Play Depth Range: 5,000-18,000 feet*

*Play Exploration Chance: 0.048*

Play 3, Lisburne Carbonates, 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	213	933
Total Gas (Tcfg)	0.000	0.544	2.339
Total Liquids (Mmbo)	0	116	517
Free Gas** (Tcfg)	0.000	0.249	1.013
Solution Gas (Tcfg)	0.000	0.295	1.326
Oil (Mmbo)	0	103	462
Condensate (Mmbc)	0	13	55
* 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 3, the “Lisburne Carbonates” play, is the 17<sup>th</sup>-ranking play (of 29 plays) in the Chukchi Sea OCS Planning Area, with 0.7% (213 Mmboe) of the Planning Area energy endowment (29,041 Mmboe). The overall assessment results for play 3 are shown in [table 1](#). Oil and gas-condensate liquids form 55% of the hydrocarbon energy endowment of play 3. [Table 5](#) reports the detailed

assessment results by commodity for play 3.

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

Reservoir objectives include Mississippian to Permian carbonates that were deposited on a stable marine shelf, with perhaps deeper water facies in the southeast part of the province in axial parts of Hanna trough (mostly in play 4). Porosity in the Lisburne carbonates is associated with sparse porous zones in limestones and thin dolomite beds.

No reef facies have been documented within the Lisburne carbonate assemblage, which ranges in age from Mississippian to Permian. The play is primarily charged by stratigraphically-younger rocks of the Hanna trough play charging system, with possible minor contributions from interbedded organically-lean and gas-prone shales. Incomplete penetrations of the Lisburne carbonates occurred at Popcorn and Crackerjack wells (in play 3) and Diamond well (in play 4). These wells encountered Lisburne carbonates with porosity values ranging from 0 to 14 percent. Trace oil shows were noted in Lisburne carbonates in Popcorn and Diamond wells.

A maximum of 24 hypothetical pools is forecast by the aggregation of the risk model and the prospect numbers model for play 3. These 24 pools range in mean conditional (un-risked) recoverable volumes from 3 Mmboe (pool rank 24) to 273 Mmboe (pool rank 1). Pool rank 1 ranges in possible conditional recoverable volumes from 45

Mmboe (F95) to 865 Mmboe (F05). Table 2 shows the conditional sizes of the 10 largest pools in play 3.

Play 3, Lisburne Carbonates, 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	45	273	865
2	21	114	279
3	11	66	165
4	6	43	110
5	4	30	78
6	3	22	59
7	2	17	45
8	2.0	14	36
9	1.7	11	30
10	1.5	10	25
<p>* Conditional, Technically-Recoverable, Millions of Barrels Energy-Equivalent (Mmboe), from "PSRK.out" file</p> <p>F95 = 95% chance that resources will equal or exceed the given quantity</p> <p>F05 = 5% chance that resources will equal or exceed the given quantity</p> <p>BOE = total hydrocarbon energy, expressed in barrels-of-oil-equivalent, where 1 barrel of oil = 5,620 cubic feet of natural gas</p>			

**Table 2**

In the computer simulation for play 3 a total of 30,480 "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 11 contains the largest share (5,775, or 19%) of simulation pools (conditional, technically recoverable BOE resources) for play 3. Pool size class 11 ranges from 32 to 64 Mmboe. The largest 9 simulation pools for play 3 fall within pool size class 17, which ranges in size from 2,048 to 4,096 Mmboe. Table 6 reports statistics for the simulation pools developed in the GRASP computer model for play 3.

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

**Basin:** Chukchi Sea Planning Area  
**Play Number:** 03  
**Play UAI Number:** AAAAA DAD

**Assessor:** K.W. Sherwood  
**Play Name:** Lisburne Carbonates

**Date:** January 2005

**Play Area:** mi<sup>2</sup> (million acres) 11,608 (7.429)  
**Reservoir Thermal Maturity:** % Ro 0.7-2.00

**Play Depth Range:** feet 5,000-18,000 (mean = 13,130)  
**Expected Oil Gravity:** ° API 30  
**Play Water Depth Range:** feet 90-170 (mean = 100)

### 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*	700		1717		7890	16019/28306			36263				122492
Prospect Area (acres)-Model Output**	704	1267	1825	3564	7914	14335/18032	17010	25964	34148	52245			121143
Fill Fraction (Fraction of Area Filled)	0.18	0.30	0.32	0.37	0.43	0.44/0.10	0.50	0.54	0.57	0.62			1.00
Productive Area of Pool (acres)***	200	531	765	1535	3397	6335/8311	7506	11467	15136	23081	28000	31000	69351
Pay Thickness (feet)	10	31	38	50	70	79/41	97	116	131	156	190	217	500

\* 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	0.4
Output Play Level Chance*	0.3996

Prospect Level Chance	0.12
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Exploration Chance	0.048
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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 (presence of seal)	0.5
0.7		Reservoir Presence	
		Chance Porosity > 8% (carbonate reservoir)	0.4
		Adequate Migration (long distance, stratigraphically-down)	0.6

Fractile	F99	F95	F90	F75	F50	Mean/Std. Dev.	F25	F15	F10	F05	F02	F01	F00
Numbers of Prospects in Play	48	52	55	58	62	63.52/7.28	68	70	72	76	79	80	96
Numbers of Pools in Play						3.05/4.12	7	8	9	11	12	13	24

Zero Pools at F39.98

Minimum Number of Pools	5 (F35)	Mean Number of Pools	3.05	Maximum Number of Pools	24
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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)	22	46	53	68	93	109/60	132	161	184	222	270	310	633
Gas Recovery Factor (Mcfg/acre-foot)	32	177	217	283	381	423/205	518	605	672	805	960	1150	2227
Gas Oil Ratio (Sol'n Gas)(cf/bbl)	540	1950	2150	2500	2850	2866/654	3300	3500	3650	3850	4100	4250	5200
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):	$\mu$ (mu)= 10.314	$\sigma^2$ (sigma squared)= 1.816	Random Number Generator Seed= 945114
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BOE Conversion Factor (cf/bbl)	5620	Probability Any Pool Contains Both Oil and Free Gas (Gas Cap)	0.6
Probability Any Pool is 100% Oil	0.2	Fraction of Pool Volume Gas-Bearing in Oil Pools with Gas Cap	0.3
Probability Any Pool is 100% Gas	0.2		

Table 3. Input data for Chukchi Sea play 1, 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: AAAAADAD</b>		<b>Play No. 3</b>		
World	Level -	World	Level	Resources
Country	Level -	UNITED	STATES	OF AMERICA
Region	Level -	MMS	-	ALASKA REGION
Basin	Level -	<b>CHUKCHI</b>	<b>SEA</b>	<b>SHELF</b>
<b>Play</b>	<b>Level -</b>	<b>Play</b>		<b>3 Lisburne Carbonates</b>
Geologist	Kirk W.	Sherwood		
Remarks	2005 Assessment			
Run Date & Time:	Date	19-Sep-05 Time	13:52:13	

**Summary of Play Potential**

Product	MEAN	Standard Deviation
<b>BOE (Mboe)</b>	213,280	364,210
<b>Oil (Mbo)</b>	102,970	188,930
<b>Condensate (Mbc)</b>	13,482	29,834
<b>Free (Gas Cap &amp; Nonassociated) Gas (Mmcfg)</b>	249,480	501,230
<b>Solution Gas (Mmcfg)</b>	294,730	545,220

10000 (Number of Trials in Sample)

0.3996 (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	0	0	0	0	0
40	12,575	5,413	983	19,534	15,192
35	173,080	78,734	12,433	239,140	221,210
30	262,110	121,140	18,013	346,860	344,150
25	348,320	160,600	24,152	459,010	460,210
20	442,780	203,890	30,820	587,600	581,760
15	544,080	263,650	35,109	630,660	748,040
10	694,460	327,950	45,425	861,260	943,250
8	776,060	386,890	47,413	848,650	1,072,000
6	874,590	418,330	56,618	1,049,400	1,196,500
5	932,800	461,640	55,007	1,013,000	1,325,700
4	1,015,600	511,700	57,237	1,050,600	1,459,500
2	1,277,200	620,050	74,640	1,462,700	1,810,800
1	1,545,600	800,210	79,534	1,412,800	2,329,500
0.1	2,695,300	1,401,800	151,000	2,362,400	4,058,200
0.01	4,557,900	2,903,000	12,916	284,160	8,943,700
0.001	4,789,900	3,123,700	119,830	1,904,200	6,786,600

**Table 5.** Assessment results by commodity for Chukchi Sea play 3, 2006 assessment.

Basin: CHUKCHI SEA SHELF Play 03 - Lisburne UAI Key: AAAAADAD				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	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	7	0.022966	0.0007	0.001751	0	0	7	0	0	0	0	0	1	1	1	1	1	0.140174	0.237074
4	0.25	0.5	32	0.104987	0.0032	0.008006	9	2	21	1	1	1	1	1	1	2	1	2	2	0.251834	0.467217
5	0.5	1	141	0.462598	0.0141	0.035276	55	15	71	1	2	1	1	1	1	1	1	2	2	0.505639	0.998527
6	1	2	516	1.692913	0.0516	0.129097	258	86	172	1	2	1	2	1	2	1	2	1	2	1.015207	1.998519
7	2	4	1470	4.822834	0.147	0.367776	782	238	450	1	3	1	2	1	2	1	2	1	4	2.000104	3.998226
8	4	8	3013	9.885171	0.3013	0.753815	1663	519	831	1	4	1	2	1	3	1	3	1	5	4.003146	7.998150
9	8	16	4700	15.419948	0.47	1.175882	2848	816	1036	1	6	1	3	1	4	1	4	1	7	8.000030	15.993300
10	16	32	5715	18.75	0.5715	1.429822	3506	1067	1142	1	5	1	3	1	3	1	3	1	7	16.000376	31.997183
11	32	64	5775	18.94685	0.5775	1.444834	3562	1164	1049	1	6	1	3	1	3	1	3	1	7	32.005477	63.982757
12	64	128	4743	15.561024	0.4743	1.18664	2956	1041	746	1	5	1	3	1	3	1	3	1	7	64.017223	127.991240
13	128	256	2810	9.21916	0.281	0.703027	1728	669	413	1	4	1	3	1	2	1	2	1	7	128.072340	255.791301
14	256	512	1168	3.832021	0.1168	0.292219	722	297	149	1	3	1	2	1	2	1	2	1	3	256.079111	511.229998
15	512	1024	319	1.046588	0.0319	0.07981	189	96	34	1	2	1	2	1	1	1	1	1	2	512.471865	1022.853000
16	1024	2048	62	0.203412	0.0062	0.015512	43	16	3	1	1	1	1	1	1	1	1	1	2	1034.073000	1875.822000
17	2048	4096	9	0.029528	0.0009	0.002252	3	5	1	1	1	1	1	1	1	1	1	1	1	2067.103000	3964.508000
18	4096	8192	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000
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											Below Class			0.000000
Totals			30480	100.000008	3.048	7.625719	Above Class											Above Class			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: 3997																					

**Table 6.** Statistics for simulation pools created in computer sampling run for Chukchi Sea play 3, 2006 assessment.

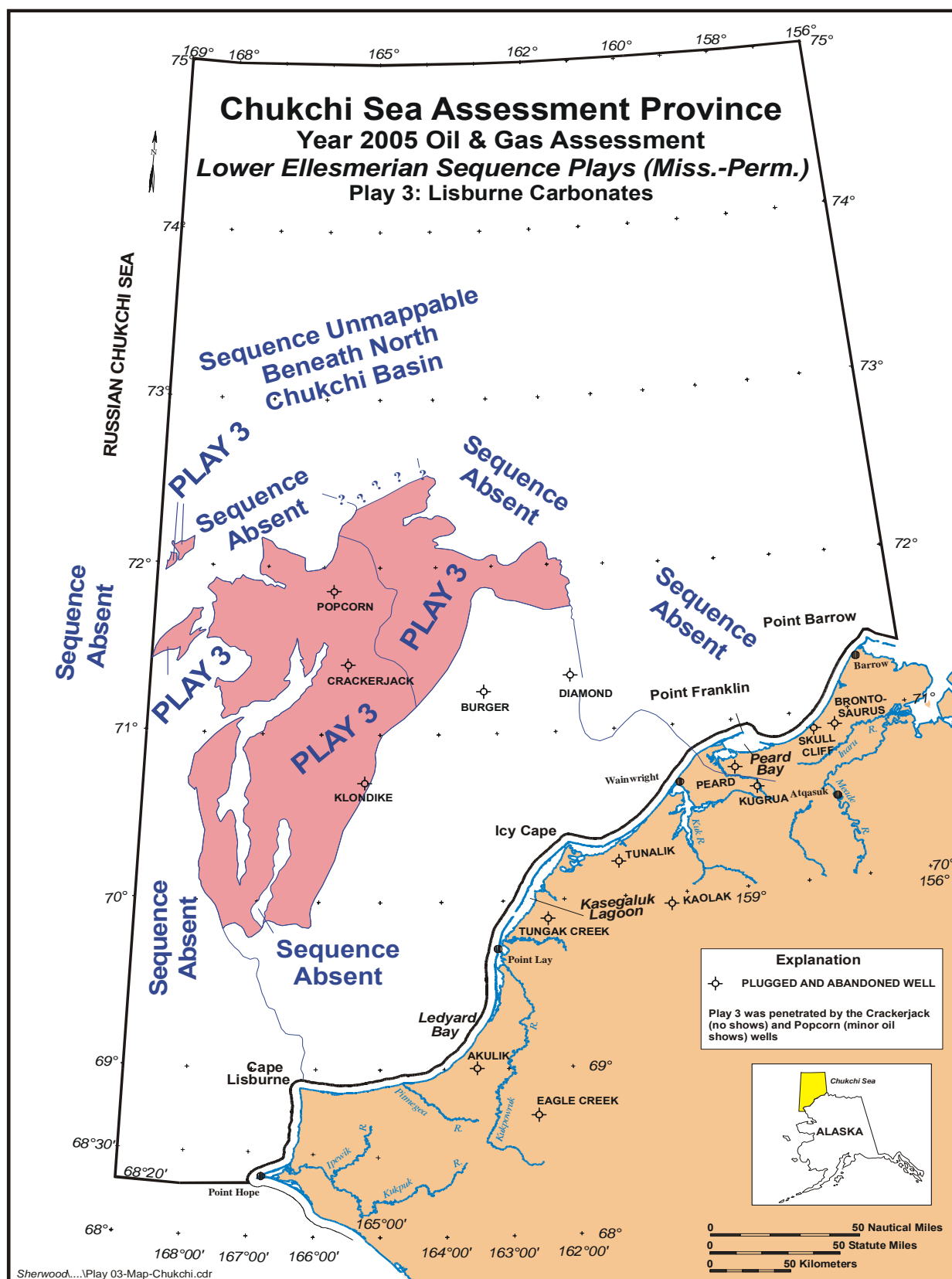


Figure 1. Map location of Chukchi Sea play 3, 2006 assessment.