Chukchi Sea Play 4: Ellesmerian-Deep Gas

Geological Assessment

<u>GRASP UAI</u>: AAAAA DAE <u>Play Area</u>: 15,707 square miles <u>Play Water Depth Range</u>: 115-250 feet <u>Play Depth Range</u>: 10,394-37,160 feet <u>Play Exploration Chance</u>: 0.018

Play 4, Ellesmerian-Deep Gas, Chukchi Sea OCS Planning Area, 2006 Assessment, Undiscovered Technically-Recoverable Oil & Gas												
Assessment Results as of November 2005 Resource Resource *												
Commodity (Units)	F95	Mean	F05									
BOE (Mmboe)	0	198	719									
Total Gas (Tcfg)	0	1	4									
Total Liquids (Mmbo)	0	25	90									
Free Gas** (Tcfg)	0.000	0.977	3.539									
Solution Gas (Tcfg)	0.000	0.000	0.000									
Oil (Mmbo)	0	0	0									
Condensate 0 25 90												
* Risked, Technically-Recoverable ** Free Gas Includes Gas Cap and Non-Associated Gas F95 = 95% chance that resources will equal or exceed the given guantity												

F05 = 5% chance that resources will equal or exceed the given quantity

BOE = total hydrocarbon energy, expressed in barrels-of-oilequivalent, where 1 barrel of oil = 5,620 cubic feet of natural gas

Mmb = millions of barrels

Tcf = trillions of cubic feet

Table 1

Play 4, the "Ellesmerian-Deep Gas" play, is the 18th-ranking play (of 29 plays) in the Chukchi Sea OCS Planning Area, with 0.7% (198 Mmboe) of the Planning Area energy endowment (29,041 Mmboe). Play 4 is assessed as offering non-associated gas in all pools. The overall assessment results for play 4 are shown in table 1. Gas-condensate liquids form 13% of the hydrocarbon energy endowment of play 4. Table 5 reports the detailed assessment results by commodity for play 4.

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

The reservoir objectives for play 4 include all potential reservoirs in both Lower Ellesmerian and Upper Ellesmerian sequences (reservoir strata described in plays 1,2,3,5, and 6).

Prospects in play 4 occur at subsurface depths beneath the petroleum liquid survival "floor" (2.0% vitrinite reflectance) and should contain only non-associated gas. High thermal maturities have a detrimental effect on reservoir properties and multicycle tectonic history combined with extremely deep burial at present (to 38,000 ft) result in high exploration risks for play 4. Play 4 was penetrated at Tunalik well in northwestern Alaska with minor gas shows in the Shublik Formation.

A maximum of 27 hypothetical pools is forecast by the aggregation of the risk model and the prospect numbers model for play 4. These 27 pools range in mean conditional (un-risked) recoverable volumes from 3 Mmboe or 0.016 Tcfge (pool rank 27) to 185 Mmboe or 1.040 Tcfge (pool rank 1). Pool rank 1 ranges in possible conditional recoverable volumes from 26 Mmboe or 0.146 Tcfge (F95) to 504 Mmboe or 2.832 Tcfge (F05). Table 2 shows the conditional sizes of the 10 largest pools in play 4.

Assessment Results as of November 2005										
		E Resource								
Pool Rank	F95	Mean	F05							
1	26	185	504							
2	11	74	189							
3	6	45	113							
4	4	32	80							
5	3	3 24 60								
6	2.5	2.5 19 4								
7	2.1	16	41 35 31							
8	1.9	14								
9	1.7	12								
10	1.6	11	27							
* Conditional, Techni Energy-Equivalent (N										
F95 = 95% chance th given quantity	at resources w	vill equal or ex	ceed the							
F05 = 5% chance tha quantity	t resources wil	ll equal or exc	eed the given							
BOE = total hydrocar equivalent, where 1 b gas	0,	•								

Play 4, Ellesmerian-Deep Gas, Chukchi Sea OCS

Table 2

In the computer simulation for play 4 a total of 31,927 "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 (7,356, or 23%) of simulation pools (conditional, technically recoverable BOE resources) for play 4. Pool size class 11 ranges from 32 to 64 Mmboe (or 0.2-0.4 Tcfge). The largest 3 simulation pools for play 4 fall within pool size class 17, which ranges in size from 2,048 to 4,096 Mmboe (or 12-23 Tcfge). Table 6 reports statistics for the simulation pools developed in the GRASP computer model for play 4.

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

Play Number: 04 Play UAI Number: AAAAA DAE				K.W. She E: Ellesme	rwood rian-Deep (Gas	<u>Date</u> : January 2005								
<u>Play Area</u> : mi ² (million acres) <u>Reservoir Thermal Maturity</u> : % Ro	15,707 (10 2.11 - >8.0	5,707 (10.053) Play Depth Range: feet 10,394-37,160 (mean = 22, 10,394-37,160 (mean = 12, 10,394-37,160 (mean = 13, 10,394-37,160 (mean = 1								ee oil)					
POOLS Module (Volumes of	F Pools	, Acre-l	Feet)												
Fractile	F100	F95	F90	F75	F50	Mean/Std. Dev.	F25	F15	F10	F05	F02	F01	F00		
Prospect Area (acres)-Model Input*	500		3259		11225	17882/22178			38665				323676		
Prospect Area (acres)-Model Output**	581	2293	3288	5912	11174	17247/19385	20988	30019	37658	52187			287149		
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)***	208	919	1367	2451	4777	7634/9099	9109	13315	16862	23470	31000	38000	125296		
Pay Thickness (feet) * model fit to prospect area data in BESTFIT	10	38	44	55	70	75/29	90	103	113	129	150	166	350		
Input Play Level Chance Output Play Level Chance* * First Occurrence of Non Zero Pools As Reported in PSUM	0.6 0.5941 Module		Prospect			0.03	I		Exploratio			0.018	J		
Risk Model	Play 0	Chance	1		Pet	roleum System Fac	ctors			Prospec	t Chance	1			
	C).6			Reser		0	03							
		Chance Porosity > 10%													
					C	Chance Porosity > 10)%			0	01				
					C	Chance Porosity > 10)%			0	01	-			
					C	Chance Porosity > 10	0%			0	01				
Fractile		F95	E90	E75	1	1		E15	E10			F01	FOO		
	F99 92	F95 105	F90 130	F75 145	F50 170	Chance Porosity > 10	F25 200	F15 220	F10 240	0 F05 260	01 F02 280	F01 300	F00 460		
Fractile Numbers of Prospects in Play Numbers of Pools in Play					F50	Mean/Std. Dev.	F25			F05	F02				
Numbers of Prospects in Play		105			F50 170	Mean/Std. Dev. 177.28/47.16	F25 200	220	240	F05 260	F02 280	300	460		
Numbers of Prospects in Play	92	105	130		F50 170 3	Mean/Std. Dev. 177.28/47.16	F25 200	220 7	240	F05 260 9	F02 280	300	460		
Numbers of Prospects in Play Numbers of Pools in Play	92 Zero Pools 2 (F55)	105 at F59.43	130 Mean	145	F50 170 3	Mean/Std. Dev. 177.28/47.16 3.19/3.33	F25 200	220 7	240 8	F05 260 9	F02 280 11	300	460		
Numbers of Prospects in Play Numbers of Pools in Play Minimum Number of Pools	92 Zero Pools 2 (F55)	105 at F59.43	130 Mean	145	F50 170 3	Mean/Std. Dev. 177.28/47.16 3.19/3.33	F25 200	220 7	240 8	F05 260 9	F02 280 11	300	460		
Numbers of Prospects in Play Numbers of Pools in Play Minimum Number of Pools POOLS/PSRK/PSUM Module	92 Zero Pools 2 (F55) es (Play	105 at F59.43 y Reso	130 Mean urces)	145 Number o	F50 170 3 f Pools	Mean/Std. Dev. 177.28/47.16 3.19/3.33 3.19 Mean/Std. Dev.	F25 200 6	220 7 Maximu	240 8 m Number	F05 260 9 of Pools	F02 280 11 27	300 12	460 27		
Numbers of Prospects in Play Numbers of Pools in Play Minimum Number of Pools POOLS/PSRK/PSUM Module Fractile	92 Zero Pools 2 (F55) es (Play	105 at F59.43 y Reso	130 Mean urces)	145 Number o	F50 170 3 f Pools	Mean/Std. Dev. 177.28/47.16 3.19/3.33 3.19 Mean/Std. Dev. No I 515/231	F25 200 6 F25 Free Oil 623	220 7 Maximu	240 8 m Number	F05 260 9 of Pools	F02 280 11 27	300 12	460 27		
Numbers of Prospects in Play Numbers of Pools in Play Minimum Number of Pools POOLS/PSRK/PSUM Module Fractile Oil Recovery Factor (bbl/acre-foot)	92 Zero Pools 2 (F55) es (Pla: F100	105 at F59.43 y Reso F95	130 Mean urces) F90	145 Number o F75	F50 170 3 f Pools F50	Mean/Std. Dev. 177.28/47.16 3.19/3.33 3.19 Mean/Std. Dev. No I 515/231	F25 200 6 F25 Free Oil	220 7 Maximu F15	240 8 m Number F10	F05 260 9 of Pools F05	F02 280 11 27 F02	300 12 F01	460 27 F00		
Numbers of Prospects in Play Numbers of Pools in Play Minimum Number of Pools POOLS/PSRK/PSUM Module Fractile Oil Recovery Factor (bbl/acre-foot) Gas Recovery Factor (Mcfg/acre-foot) Gas Oil Ratio (Sol'n Gas)(cf/bbl)	92 Zero Pools 2 (F55) es (Pla: F100	105 at F59.43 y Reso F95	130 Mean urces) F90	145 Number o F75	F50 170 3 f Pools F50	Mean/Std. Dev. 177.28/47.16 3.19/3.33 3.19 Mean/Std. Dev. No I 515/231	F25 200 6 F25 Free Oil 623	220 7 Maximu F15	240 8 m Number F10	F05 260 9 of Pools F05	F02 280 11 27 F02	300 12 F01	460 27 F00		
Numbers of Prospects in Play Numbers of Pools in Play Minimum Number of Pools POOLS/PSRK/PSUM Module Fractile Oil Recovery Factor (bbl/acre-foot) Gas Recovery Factor (Mcfg/acre-foot) Gas Oil Ratio (Sol'n Gas)(cf/bbl) Condensate Yield ((bbl/Mmcfg)	92 Zero Pools 2 (F55) ES (Pla) F100 22 13	105 at F59.43 y Reso F95 227 18	130 Mean UrCES) F90 273	145 Number o F75 357 22	F50 170 3 f Pools F50 474	Mean/Std. Dev. 177.28/47.16 3.19/3.33 3.19 Mean/Std. Dev. No I 515/231 No I	F25 200 6 F25 Free Oil 623 Free Oil	220 7 Maximu F15 733	240 8 m Number F10 811 31	F05 260 9 of Pools F05 948 33	F02 280 11 27 F02 1100	300 12 F01 1250	460 27 F00 2034 50		
Numbers of Prospects in Play Numbers of Pools in Play Minimum Number of Pools POOLS/PSRK/PSUM Module Fractile Oil Recovery Factor (bbl/acre-foot) Gas Recovery Factor (Mcfg/acre-foot)	92 Zero Pools 2 (F55) ES (Pla) F100 22 13	105 at F59.43 y Reso F95 227 18	130 Mean Urces) F90 273 19 μ (mu)= 10	145 Number o F75 357 22 0.346	F50 170 3 f Pools F50 474 25 σ² (sigma)	Mean/Std. Dev. 177.28/47.16 3.19/3.33 3.19 Mean/Std. Dev. No I 515/231 No I 25/5	F25 200 6 F25 Free Oil 623 Free Oil 28	220 7 Maximu F15 733 30	240 8 m Number F10 811 31	F05 260 9 of Pools F05 948 33	F02 280 11 27 F02 1100	300 12 F01 1250 38	460 27 F00 2034 50		
Numbers of Prospects in Play Numbers of Pools in Play Minimum Number of Pools POOLS/PSRK/PSUM Module Fractile Oil Recovery Factor (bbl/acre-foot) Gas Recovery Factor (Mcfg/acre-foot) Gas Oil Ratio (Sol'n Gas)(cf/bbl) Condensate Yield ((bbl/Mmcfg) Pool Size Distribution Statistics from <i>POOLS</i>	92 Zero Pools 2 (F55) es (Play F100 22 13 (1,000 BO	105 at F59.43 y Reso F95 227 18	130 Mean Urces) F90 273 19 μ (mu)= 10 Probabilit	145 Number o F75 357 22 0.346 y Any Poo	F50 170 3 f Pools F50 474 25 σ² (sigma I Contains	Mean/Std. Dev. 177.28/47.16 3.19/3.33 3.19 Mean/Std. Dev. No I 515/231 No I 25/5 squared)= 1.474	F25 200 6 F25 Free Oil 623 Free Oil 28 Gas (Gas 0	220 7 Maximu F15 733 30	240 8 m Number F10 811 31	F05 260 9 of Pools F05 948 33 Number Ge	F02 280 11 27 F02 1100	300 12 F01 1250 38	460 27 F00 2034 50		

 Table 3. Input data for Chukchi Sea play 4, 2006 assessment.

		Risk Analysis Form -	2006 National Assessr	nent				
Ass	essment Province:	Chukchi Sea OCS Planning Area	: 4. Ellesmerian - Deep Gas					
	Assessor(s):	K.W. Sherwood	AAAA	A DAE				
	Date:	1-Jan-05						
ertai	nty) based on consid	<i>antitative</i> probability of success (i.e., between ze eration of the <i>qualitative</i> assessment of ALL eler m geologic parameter assumptions have been m	ments within the component was		d. This is the asse	ssment of the		
					Play Chance Factors	Averge Condition Prospect Chance		
1. H		component (1a * 1b * 1c)		1	1.0000	1.0000		
	Probability of effi rock of adequate	uality, Effective, Mature Source Rock cient source rock in terms of the existence of suff quality located in the drainage area of the reserv		1a	1.00	1.00		
	b. Effective Expuls Probability of effe reservoirs.	sion and Migration active expulsion and migration of hydrocarbons free	1b	1.00	1.00			
	c. Preservation Probability of effe	ective retention of hydrocarbons in the prospects	1c	1.00	1.00			
2. F	Reservoir compo	nent (2a * 2b)		2	0.6000	0.0300		
		ervoir facies sence of reservoir facies with a minimum net thic esource assessment).	kness and net/gross ratio (as	2a	0.60	1.00		
		y ectiveness of the reservoir, with respect to minimu specified in the resource assessment).	um effective porosity, and	2b	1.00	0.03		
3. 1	Frap component	(3a * 3b)		3	1.0000	1.0000		
F	a. Presence of trap Probability of pre assessment).	o sence of the trap with a minimum rock volume (a:	s specified in the resource	3a	1.00	1.00		
	b. Effective seal m							
	Probability of effe	ective seal mechanism for the trap.		3b	1.00	1.00		
ve		(Marginal Probability of hydrocarbons,	MPhc)		0.6000			
	(1 ^ 2 ^ 3) Produ	ct of All Subjective Play Chance Factors						
ver	age Conditional	Prospect Chance ¹ ct of All Subjective Conditional Prospect Chance	Factors			0.0300		
	¹ Assumes that	the Play exists (where all play chance factors stent with play chance and prospect distributions	= 1.0)	3 of Guid	le			
xpl	oration Chance	all Play Chance and Average Conditional Prospe	ct Chance)		0.	0180		
		nce document for explanation of the Risk Analysio orosity >10%, Based on Regional Mo		rvoir T	nermal Maturit	v		
			,					

 Table 4. Risk model for Chukchi Sea play 4, 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: AAAAADAE Play No. 4 World World Level Level Resources -Country Level UNITED STATES OF AMERICA Level MMS ALASKA REGION Region Basin Level сниксні SEA SHELF Play Level 4 Ellesmerian Deep Gas Play Geologist Sherwood Kirk W. 2005 Assessment Remarks Run Date & Time: 19-Sep-05 Time Date 13:52:25 **Summary of Play Potential** Standard MEAN Product Deviation BOE (Mboe) 198,440 277,070 Oil (Mbo) 0 0 Condensate (Mbc) 24,631 34,836 Free (Gas Cap & Nonassociated) 976,810 1,363,300 Gas (Mmcfg) Solution Gas 0 0 (Mmcfg) 10000 (Number of Trials in Sample) 0.5941 (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	55,514	0	6,736	274,140	0		
50	99,507	0	11,994	491,820	0		
45	137,720	0	17,150	677,630	0		
40	175,250	0	21,235	865,550	0		
35	215,930	0	26,654	1,063,700	0		
30	258,120	0	31,696	1,272,500	0		
25	309,080	0	37,865	1,524,200	0		
20	366,410	0	45,740	1,802,200	0		
15	436,520	0	54,479	2,147,100	0		
10	532,970	0	67,223	2,617,500	0		
8	585,980	0	72,999	2,882,900	0		
6	660,330	0	81,416	3,253,500	0		
5	719,240	0	89,586	3,538,700	0		
4	783,820	0	99,346	3,846,800	0		
2	992,490	0	124,300	4,879,200	0		
1	1,270,000	0	162,430	6,224,300	0		
0.1	2,031,000	0	238,190	10,076,000	0		
0.01	2,791,400	0	359,850	13,665,000	0		
0.001	3,324,900	0	413,780	16,360,000	0		

 Table 5. Assessment results by commodity for Chukchi Sea play 4, 2006 assessment.

		EA SHELF				Model Simu	lation "Pools	" Report	ed by "l	Fieldsiz	e.out" G	RASP M	odule										
		ian - Deep (Gas																				
UAI Key	<mark>: AAAAAD</mark>	DAE																					
	Classifica	tion and Size		Poo	I Count Statis	stics		Pool	Types C	ount	Mixed Po	ol Range	Oil Poo	l Range	Gas Po	ol Range	Total Po	ol Range			Pool Resource S	Statistics (MMBOE)	
										1		g-				l							
Class	Min (MMBOE)	Max (MMBOE)	Pool Count	Percentage	Trial Average	Trials w/Pool Avg		Mixed Pool	Oil Pool	Gas Pool	Min	Мах	Min	Max	Min	Мах	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		0.000000	0.000000	0.000000	0.00000
2	0.0625	0.125	1	0.003132	0.0001	0.000168		0	0	1	0	0	0	0	1	1	1	1		0.090449	0.090449	0.090449	90.44911
3	0.125	0.25	8	0.025057	0.0008	0.001346		0	0	8	0	0	0	0	1	1	1	1		0.177738	0.239098	1.717603	214.70038
4	0.25	0.5	33	0.103361	0.0033	0.005554		0	0	33	0	0	0	0	1	1	1	1		0.252272	0.491783	12.948309	392.37299
5	0.5	1	127	0.397782	0.0127	0.021373		0	0	127	0	0	0	0	1	2	2 1	2		0.507585	0.995192	99.696686	785.01325
6	1	2	423	1.324897	0.0423	0.071188		0	0	423	0	0	0	0	1	2	2 1	2		1.006770	1.998570	661.557963	1.56396
7	2	4	1108	3.470417	0.1108	0.186469		0	0	1108	0	0	0	0	1	3	3 1	3		2.000925	3.993714	3358.559000	3.03119
8	4	8	2479	7.764588	0.2479	0.4172		0	0	2479	0	0	0	0	1	5	i 1	5		4.004084	7.998548	15023.743000	6.06040
9	8	16	4736	14.833839	0.4736	0.797038		0	0	4736	0	0	0	0	1	7	1 1	7		8.004209	15.996604	56380.367000	11.90463
10	16	32	6744	21.123188	0.6744	1.134971		0	0	6744	0	0	0	0	1	8	3 1	8		16.004296	31.999385	157223.586000	23.31310
11	32	64	7356	23.04006	0.7356	1.237967		0	0	7356	0	0	0	0	1	9) 1	9		32.008574	63.993311	336837.716000	45.79088
12	64	128	5285	16.553387	0.5285	0.889431		0	0	5285	0	0	0	0	1	6	5 1	6		64.004531	127.970166	474475.247000	89.77771
13	128	256	2559	8.01516	0.2559	0.430663		0	0	2559	0	0	0	0	1	4	1	4		128.009804	255.915165	446026.976000	174.29737
14	256	512	802	2.511981	0.0802	0.134971		0	0	802	0	0	0	0	1	4	1	4		256.305742	510.992225	272614.572000	339.91842
15	512	1024	208	0.651486	0.0208	0.035005		0	0	208	0	0	0	0	1	2	2 1	2		513.144484	1022.574000	141534.655000	680.45507
16	1024	2048	55	0.172268	0.0055	0.009256		0	0	55	0	0	0	0	1	1	1	1		1026.989000	1937.686000	72264.959000	1.31390
17	2048	4096	3	0.009396	0.0003	0.000505		0	0	3	0	0	0	0	1	1	1	1		2416.112000	2757.029000	7899.982000	2.63332
18	4096	8192	0	0	0	0		0	0	0	0	0	0	0	0) 0	0 0	0		0.000000	0.000000	0.000000	0.00000
19	8192	16384	0	0	0	0		0	0	0	0	0	0	0	0) 0	0 0	0		0.000000	0.000000	0.000000	0.00000
20	16384	32768	0	0	0	0		0	0	0	0	0	0	0	0) 0	0 0	0		0.000000	0.000000	0.000000	0.00000
21	32768	65536	0	0	0	0		0	0	0	0	0	0	0	0) 0	0 0	0		0.000000	0.000000	0.000000	0.00000
22	65536	131072	0	0	0	0		0	0	0	0	0	0	0	0	0 0	0 0	0		0.000000	0.000000	0.000000	0.00000
23	131072	262144	0	0	0	0		0	0	0	0	0	0	0	0	0	0 0	0		0.000000	0.000000	0.000000	0.00000
24	262144	524288	0	0	0	0		0	0	0	0	0	0	0	0	0 0	0 0	0		0.000000	0.000000	0.000000	0.00000
25	524288	1048576	0	0	0	0		0	0	0	0	0	0	0	0	0 0	0 0	0		0.000000	0.000000	0.000000	0.00000
Vot Class			0	0	0	0	Below Class	0	0										Below Class	0.000000	0.000000	0.000000	0.00000
	l	Totals	31927	100.000008	3.1927	5.373107	Above Class	0	0	0									Above Class	0.000000	0.000000	0.000000	0.00000
											Min and	Max refe	er to num	bers of p	ools of t	he releva	ant size c	lass that				esources of the releva	ant size class
Numbe	r of Pools r	not Classifie	ed: 0								occur wi	thin any	single tria	al in the s	simulatio	n.				that occur within	any single trial in	the simulation.	
		pelow Class																					
lumbe	r of Trials v	vith Pools:	5942																				
	6 0		<u> </u>	mulation	1		•		1	•	c	CI	1 1 .	a	1		~						

Table 6. Statistics for simulation pools created in computer sampling run for Chukchi Sea play 4, 2006 assessment.

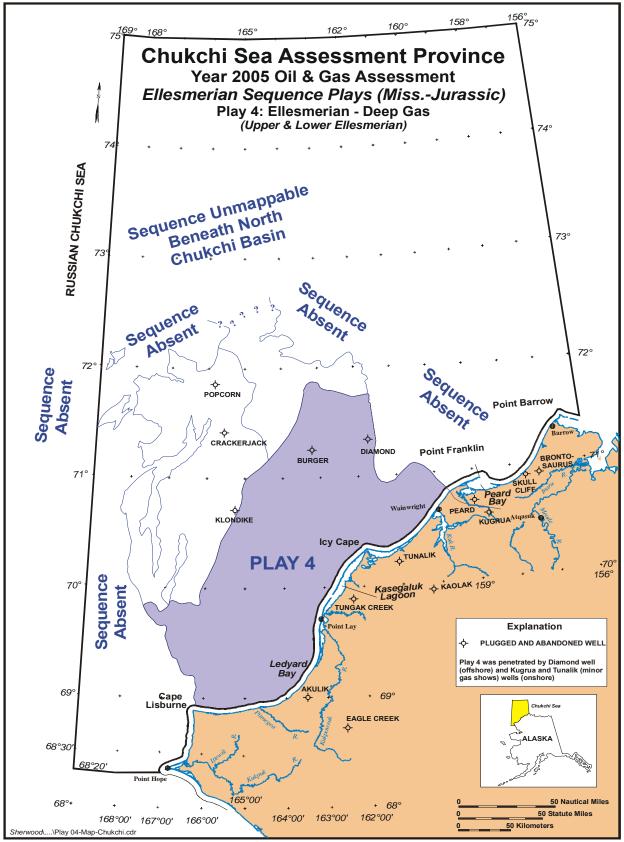


Figure 1. Map location of Chukchi Sea play 4, 2006 assessment.