Chukchi Sea Play 2: Endicott-Arctic Platform

Geological Assessment

GRASP UAI: AAAAA DAC
Play Area: 3,138 square miles
Play Water Depth Range: 90-110 feet
Play Depth Range: 3,000-13,610 feet
Play Exploration Chance: 0.10944

Play 2, Endicott-Arctic Platform, 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	122	516
Total Gas (Tcfg)	0.000	0.491	2.072
Total Liquids (Mmbo)	0	35	147
Free Gas** (Tcfg)	0.000	0.475	2.013
Solution Gas (Tcfg)	0.000	0.016	0.058
Oil (Mmbo)	0	9	37
Condensate (Mmbc)	0	26	110

** 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 2, the "Endicott-Arctic Platform" play, is the 22nd-ranking play (of 29 plays) in the Chukchi Sea OCS Planning Area, with 0.4% (122 Mmboe) of the Planning Area energy endowment (29,041 Mmboe). The overall assessment results for play 2 are shown in table 1. Oil and gas-condensate liquids form 29% of the hydrocarbon energy endowment of play 2. Table 5 reports the detailed assessment results by commodity for play 2.

Table 3 summarizes the volumetric input data developed for the *GRASP* computer model of Chukchi Sea play 2. Table 4 reports the risk model used for play 2. The location of play 2 is shown in figure 1.

Reservoir objectives primarily include Late Devonian (?) to Mississippian sandstones (equivalent to the Endicott Group) deposited in marginal- to non-marine environments in eastern Hanna trough during the early rift phase of subsidence. Early-formed horst and stratigraphic wedge traps have been buried to greater depths than their Chukchi platform counterparts in play 1 and are therefore associated with higher levels of thermal maturity and reduced chances for reservoir success.

The play is charged by the Hanna trough play charging system. Most identified prospects lie considerably deeper than the primary regional source rock (Shublik Formation), and the high thermal maturity of traps suggests the hydrocarbon endowment is largely dry gas. Play 2 is therefore modeled with a higher gas content than the other plays charged by the Hanna trough play charging system. Play 2 was not tested by any wells.

A maximum of 16 hypothetical pools is forecast by the aggregation of the risk model and the prospect numbers model for play 2. These 16 pools range in mean conditional (un-risked) recoverable volumes from 4 Mmboe (pool rank 16) to 160 Mmboe (pool rank 1). Pool rank 1 ranges in possible conditional recoverable volumes from 16 Mmboe (F95) to 457 Mmboe (F05). Table 2

shows the conditional sizes of the 10 largest pools in play 2.

Play 2, Endicott-Arctic Platform, 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	16	160	457
2	6	58	170
3	4	32	90
4	3	20	58
5	2	15	41
6	1.9	11	31
7	1.7	9	25
8	1.6	8	21
9	1.4	7	18
10	1.2	6	16

** 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

In the computer simulation for play 2 a total of 19,796 “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 (3,916, or 20%) of simulation pools (conditional, technically recoverable BOE resources) for play 2. Pool size class 10 ranges from 16 to 32 Mmboe. The largest simulation pool for play 2 falls 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 Chukchi Sea play 2.

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

Basin: Chukchi Sea Planning Area
Play Number: 02
Play UAI Number: AAAAA DAC

Assessor: K.W. Sherwood
Play Name: Endicott-Arctic Platform

Date: January 2005

Play Area: mi² (million acres) 3,138 (2.008)
Reservoir Thermal Maturity: % Ro 0.56-1.90

Play Depth Range: feet 3,000-13,610 (mean = 8,130)
Expected Oil Gravity: ° API 40
Play Water Depth Range: feet 90-110 (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*	748		1138		5786	12941/25890			29416				86445
Prospect Area (acres)-Model Output**	749	1145	1581	2864	6043	11144/13510	13811	20646	26572	39442			85935
Fill Fraction (Fraction of Area Filled)	0.18	0.30	0.32	0.37	0.43	0.44/0.10	0.50	0.54	0.58	0.62			1.00
Productive Area of Pool (acres)***	231	472	643	1217	2660	4926/6185	5953	9087	12186	17554	22000	25000	65830
Pay Thickness (feet)	10	38	44	55	70	75/29	90	103	113	129	150	166	350

* 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	0.5
Output Play Level Chance*	0.4923

Prospect Level Chance	0.21888

Exploration Chance	0.10944

* First Occurrence of Non Zero Pools As Reported in PSUM Module

Risk Model	Play Chance	Petroleum System Factors	Prospect Chance
		Seal Presence	0.8
		Reservoir Presence	0.9
		Chance Porosity > 10%	0.38
	0.5	Migration (long distance and stratigraphically-down)	0.8

Fractile	F99	F95	F90	F75	F50	Mean/Std. Dev.	F25	F15	F10	F05	F02	F01	F00
Numbers of Prospects in Play	11	13	14	16	17	18.11/3.15	19	21	22	23	25	26	33
Numbers of Pools in Play						1.98/2.39	4	5	5	6	8	8	16

Zero Pools at F49.26

Minimum Number of Pools	2 (F45)	Mean Number of Pools	1.98	Maximum Number of Pools	16

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)	17	52	62	84	125	160/120	192	250	302	387	460	510	1196
Gas Recovery Factor (Mcfg/acre-foot)	124	303	348	439	586	680/358	816	987	1120	1376	1500	1700	3197
Gas Oil Ratio (Sol'n Gas)(cf/bbl)	380	1200	1325	1550	1750	1750/380	2000	2100	2200	2325	2450	2550	3100
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)= 10.231 σ^2 (sigma squared)= 1.648

Random Number Generator Seed= 657964

BOE Conversion Factor (cf/bbl)	5620
Probability Any Pool is 100% Oil	0
Probability Any Pool is 100% Gas	0.9

Probability Any Pool Contains Both Oil and Free Gas (Gas Cap)	0.1
Fraction of Pool Volume Gas-Bearing in Oil Pools with Gas Cap	0.3

Table 3. Input data for Chukchi Sea play 2, 2006 assessment.

Risk Analysis Form - 2006 National Assessment

Assessment Province:	Chukchi Sea OCS Planning Area	**Play Number, Name:**	2. Endicott - Arctic Platform
Assessor(s):	K.W. Sherwood	**Play UAI:**	AAAAA DAC
Date:	1-Jan-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**	***0.5000***	***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	1.00	1.00
	b. Effective Expulsion and Migration			
	Probability of effective expulsion and migration of hydrocarbons from the source rock to the reservoirs.	1b	0.50	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***	***0.3420***
	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	0.90
	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	0.38
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)			***0.5000***	
	(1 * 2 * 3) *Product of All Subjective Play Chance Factors*			
Average Conditional Prospect Chance[1]				***0.2189***
	(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			***0.1094***	
	(Product of Overall Play Chance and Average Conditional Prospect Chance)			

Comments: *See guidance document for explanation of the Risk Analysis Form*

2b: Chance That Porosity >10%, Based on Regional Model for Porosity vs Reservoir Thermal Maturity

Table 4. Risk model for Chukchi Sea play 2, 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:	**AAAAADAC**		**Play No.**		**2**	
World	Level	-	World	Level	Resources	
Country	Level	-	UNITED	STATES	OF	AMERICA
Region	Level	-	MMS	-	ALASKA	REGION
Basin	Level	-	**CHUKCHI**	**SEA**	**SHELF**	
Play	**Level**	**-**	**Play**		**2**	**Endicott - Arctic Platform**
Geologist	Kirk	W.	Sherwood			
Remarks	2005	Assessment				
Run Date & Time:		Date	19-Sep-05	Time	13:52:01	

Summary of Play Potential

Product	MEAN	Standard Deviation
BOE (Mboe)	121,840	215,150
Oil (Mbo)	8,936	42,215
Condensate (Mbc)	25,618	47,901
Free (Gas Cap & Nonassociated) Gas (Mmcfg)	474,990	857,850
Solution Gas (Mmcfg)	15,531	74,928

10000 (Number of Trials in Sample)

0.4923 (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	35,785	2,796	7,426	139,240	4,424
40	70,394	3,941	14,607	284,980	6,392
35	104,750	6,445	21,344	420,870	11,635
30	141,130	9,089	28,753	563,750	16,705
25	179,550	12,475	38,059	702,070	23,001
20	226,710	12,649	47,553	913,780	22,010
15	286,100	15,569	63,954	1,135,600	25,336
10	372,110	13,850	81,633	1,529,400	25,254
8	417,810	33,328	83,292	1,634,300	58,412
6	478,580	29,785	103,440	1,888,600	52,312
5	515,500	36,616	110,290	2,013,400	58,100
4	560,590	35,553	121,100	2,209,200	60,915
2	724,250	81,967	147,540	2,636,100	144,290
1	913,690	81,625	192,530	3,452,100	142,090
0.1	1,850,400	0	618,200	6,925,100	0
0.01	3,441,200	0	846,440	14,583,000	0
0.001	5,559,800	0	1,078,600	25,185,000	0

Table 5. Assessment results by commodity for Chukchi Sea play 2, 2006 assessment.

Basin: CHUKCHI SEA SHELF
Play 02 - Endicott - Arctic Platform
UAI Key: AAAAADAC

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	0.000000	0.000000	0.000000	0.000000
2	0.0625	0.125	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000
3	0.125	0.25	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000
4	0.25	0.5	10	0.050515	0.001	0.002031		0	0	10	0	0	0	0	1	1	1	1	0.340329	0.475092	4.090974	409.097344
5	0.5	1	57	0.287937	0.0057	0.011576		1	0	56	1	1	0	0	1	1	1	1	0.504476	0.993415	46.685301	819.040358
6	1	2	272	1.374015	0.0272	0.05524		21	0	251	1	2	0	0	1	2	1	2	1.006199	1.999878	425.129462	1.562976
7	2	4	986	4.980804	0.0986	0.200244		69	0	917	1	2	0	0	1	3	1	3	2.000848	3.999384	3019.278000	3.062148
8	4	8	2123	10.724389	0.2123	0.431154		192	0	1931	1	2	0	0	1	4	1	4	4.003188	7.994898	12709.167000	5.986419
9	8	16	3261	16.473024	0.3261	0.662266		305	0	2956	1	2	0	0	1	5	1	6	8.003272	15.994526	38416.943000	11.780725
10	16	32	3916	19.781775	0.3916	0.795288		382	0	3534	1	3	0	0	1	5	1	6	16.000547	31.997954	90593.837000	23.134279
11	32	64	3894	19.670641	0.3894	0.79082		422	0	3472	1	2	0	0	1	5	1	6	32.002007	63.998447	179097.471000	45.993187
12	64	128	2863	14.462518	0.2863	0.581438		323	0	2540	1	2	0	0	1	4	1	5	64.002036	127.980600	257650.282000	89.993111
13	128	256	1649	8.329966	0.1649	0.33489		212	0	1437	1	2	0	0	1	4	1	4	128.023680	255.999120	294382.861000	178.522049
14	256	512	606	3.061224	0.0606	0.123071		83	0	523	1	1	0	0	1	3	1	3	256.082667	511.694126	208088.110000	343.379730
15	512	1024	134	0.676904	0.0134	0.027214		27	0	107	1	2	0	0	1	2	1	2	513.851190	1022.538000	91309.828000	681.416626
16	1024	2048	20	0.101031	0.002	0.004062		5	0	15	1	1	0	0	1	1	1	1	1068.158000	1895.720000	26512.463000	1.325623
17	2048	4096	4	0.020206	0.0004	0.000812		0	0	4	0	0	0	0	1	1	1	1	2067.420000	3232.642000	10533.204000	2.633301
18	4096	8192	1	0.005052	0.0001	0.000203		0	0	1	0	0	0	0	1	1	1	1	5565.213000	5565.213000	5565.213000	5.565213
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	**19796**	**99.999992**	**1.9796**	**4.020309**	Above Class	0	0	0									0.000000	0.000000	0.000000	0.000000

Number of Pools not Classified: 0
Number of Pools below Class 1: 0
Number of Trials with Pools: 4924

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.

Table 6. Statistics for simulation pools created in computer sampling run for Chukchi Sea play 2, 2006 assessment.

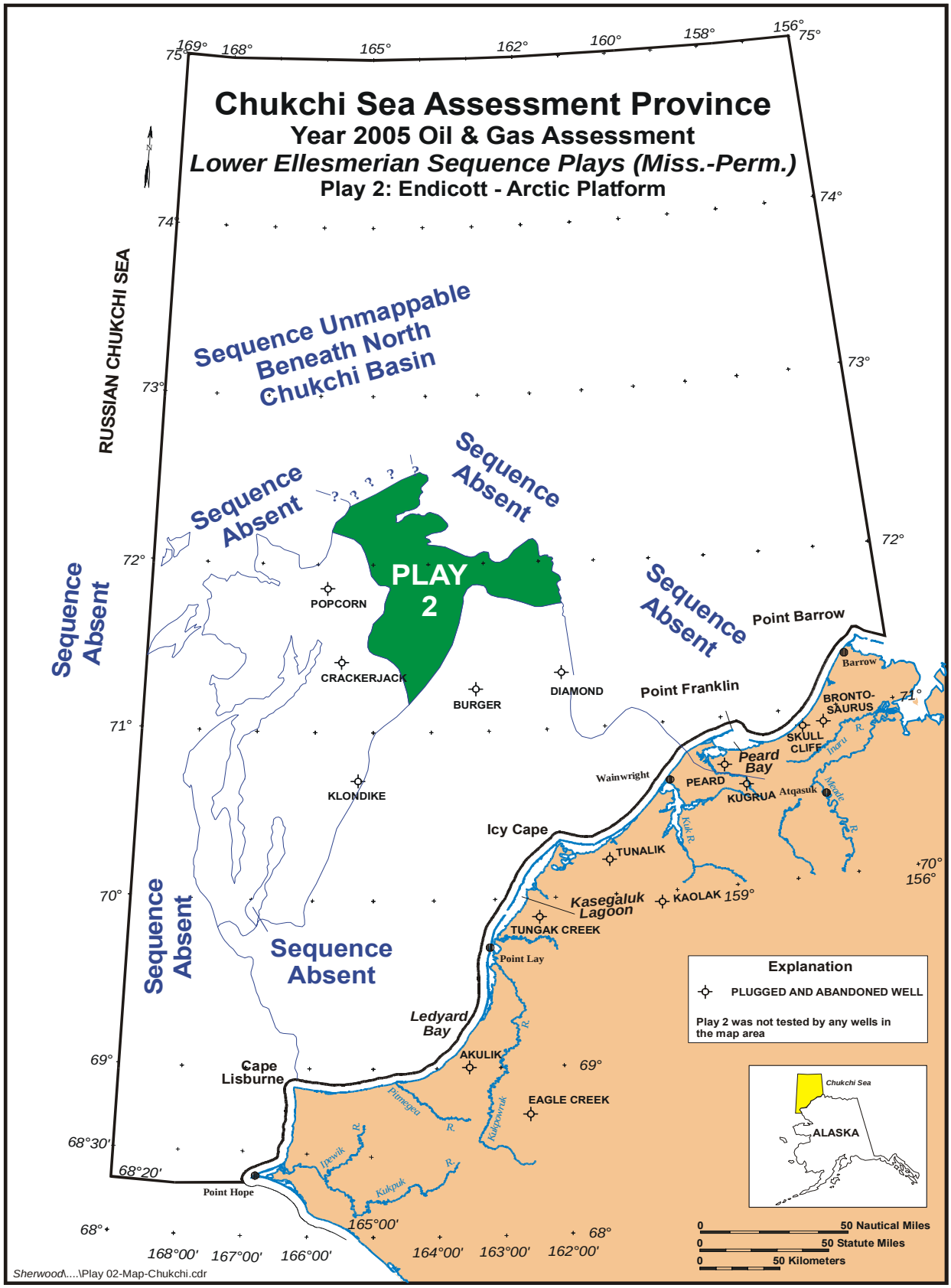

Figure 1. Map location of Chukchi Sea play 2, 2006 assessment.