Chukchi Sea Play 1: Endicott-Chukchi Platform

Geological Assessment

GRASP UAI: AAAAA DAB
Play Area: 8,470 square miles
Play Water Depth Range: 115-170 feet
Play Depth Range: 6,700-16,200 feet
Play Exploration Chance: 0.144

Play 1, Endicott-Chukchi 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	4,829	10,910
Total Gas (Tcfg)	0.000	12.347	26.348
Total Liquids (Mmbo)	0	2,632	6,222
Free Gas** (Tcfg)	0.000	6.976	13.175
Solution Gas (Tcfg)	0.000	5.371	13.173
Oil (Mmbo)	0	2,255	5,469
Condensate (Mmbc)	0	377	753

** 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 1, the "Endicott-Chukchi Platform" play, is the second most important play (of 29 plays) in the Chukchi Sea OCS Planning Area, with 17% (4,829 Mmboe) of the Planning Area energy endowment (29,041 Mmboe). The overall assessment results for play 1 are shown in table 1. Oil and gas-condensate liquids form 55% of the hydrocarbon energy endowment of play 1.

Table 5 reports the detailed assessment results by commodity for play 1.

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

Reservoir objectives primarily include Late Devonian(?) to Mississippian sandstones (equivalent to the Endicott Group) that were deposited in marginal marine to fluvial environments in western Hanna trough during the early rift or fault-driven phase of subsidence. Trap types on the east flank of Chukchi platform include early-formed horsts and areally-large stratigraphic wedges that were possibly disrupted by Paleocene transtensional faults. This play is charged by the Hanna trough play charging system, with petroleum generated from Triassic sources in Hanna trough migrating laterally westward beneath regional seals to large stratigraphic traps on Chukchi platform. Play 1 was not tested by any wells.

A maximum of 37 hypothetical pools is forecast by the aggregation of the risk model and the prospect numbers model for play 1. These 37 pools range in mean conditional (un-risked) recoverable volumes from 29 Mmboe (pool rank 37) to 1,985 Mmboe (pool rank 1). Pool rank 1 ranges in possible conditional recoverable volumes from 530 Mmboe (F95) to 5,375 Mmboe (F05). Table 2 shows the conditional sizes of the 10 largest pools in play 1.

Play 1, Endicott-Chukchi 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	530	1985	5375
2	298	1029	2147
3	184	692	1481
4	120	504	1078
5	83	384	837
6	61	303	674
7	48	246	560
8	40	205	473
9	35	175	406
10	31	152	354

** 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 1 a total of 86,963 “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 14 contains the largest share (20,194, or 23%) of simulation pools (conditional, technically recoverable BOE resources) for play 1. Pool size class 14 ranges from 256 to 512 Mmboe. The largest 49 simulation pools for play 1 fall within pool size class 19, which ranges in size from 8,192 to 16,384 Mmboe. Table 6 reports statistics for the simulation pools developed in the GRASP computer model for play 1.

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

Basin: Chukchi Sea Planning Area
Play Number: 01
Play UAI Number: AAAAA DAB

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

Date: January 2005

Play Area: mi² (million acres) 8,470 (5.420)
Reservoir Thermal Maturity: % Ro 0.65-1.92

Play Depth Range: feet 6,700-16,200 (mean = 11,360)
Expected Oil Gravity: ° API 30
Play Water Depth Range: feet 115-170 (mean = 160)

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*	3162		4599		18654	33883/51379			75660				128023
Prospect Area (acres)-Model Output**	3167	4443	5778	9526	18630	27130/24593	35508	49970	62335	81860			127966
Fill Fraction (Fraction of Area Filled)	0.18	0.29	0.32	0.37	0.43	0.44/0.10	0.5	0.54	0.57	0.61			1
Productive Area of Pool (acres)***	769	1855	2380	4114	7947	11888/11251	15693	21657	27098	36522	42000	46000	83095
Pay Thickness (feet)	10	72	84	107	140	152/64	184	212	235	271	320	357	700

* 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	0.9	Prospect Level Chance	0.16	Exploration Chance	0.144
Output Play Level Chance*	0.8996				

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

Risk Model	Play Chance	Petroleum System Factors	Prospect Chance
		Closure Definition	0.8
		Chance Porosity > 10%	0.25
		Migration (lengthy 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	35	40	43	50	59	60.39/14.06	67	75	78	82	90	96	140
Numbers of Pools in Play				6	9	8.70/4.50	12	13	14	16	18	19	37

Zero Pools at F89.98

Minimum Number of Pools	4 (F85)	Mean Number of Pools	8.7	Maximum Number of Pools	37

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)	37	93	107	139	191	228/133	275	340	396	488	540	600	1117
Gas Recovery Factor (Mcfg/acre-foot)	300	639	701	824	1024	1141/458	1331	1538	1719	2034	2400	2600	4680
Gas Oil Ratio (Sol'n Gas)(cf/bbl)	550	1650	1775	2100	2400	2376/512	2700	2850	2950	3150	3350	3450	4200
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)= 12.631 σ² (sigma squared)= 1.267
Random Number Generator Seed= 424816

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.

Risk Analysis Form - 2006 National Assessment

Assessment Province:	Chukchi Sea OCS Planning Area	**Play Number, Name:**	1. Endicott-Chukchi Platform
Assessor(s):	K.W. Sherwood	**Play UAI:**	AAAAA DAB
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**	***0.9000***	***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	0.90	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***	***0.2500***
	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	1.00
	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	0.25
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	0.80
	b. Effective seal mechanism			
	Probability of effective seal mechanism for the trap.	3b	1.00	1.00
Overall Play Chance (Marginal Probability of hydrocarbons, MPhc)			***0.9000***	
	(1 * 2 * 3) *Product of All Subjective Play Chance Factors*			
Average Conditional Prospect Chance[1]				***0.1600***
	(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			***0.1440***	
	(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 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

Play UAI:	**AAAAADAB**		**Play No.**		**1**	
World	Level	-	World	Level	Resources	
Country	Level	-	UNITED	STATES	OF	AMERICA
Region	Level	-	MMS	-	ALASKA	REGION
Basin	Level	-	**CHUKCHI**	**SEA**	**SHELF**	
Play	**Level**	**-**	**Play**		**1**	**Endicott - Chukchi Platform**
Geologist	Kirk	W.	Sherwood			
Remarks	2005	Assessment				
Run Date & Time:		Date	19-Sep-05	Time	13:51:50	

Summary of Play Potential

Product	MEAN	Standard Deviation
BOE (Mboe)	4,828,800	3,322,300
Oil (Mbo)	2,255,100	1,745,000
Condensate (Mbc)	376,730	328,780
Free (Gas Cap & Nonassociated) Gas (Mmcfg)	6,975,900	5,732,900
Solution Gas (Mmcfg)	5,370,800	4,250,700

10000 (Number of Trials in Sample)
0.8996 (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	145,200	62,902	12,837	240,780	149,570
85	1,540,500	710,530	121,860	2,332,900	1,646,800
80	2,125,700	974,000	176,090	3,204,600	2,278,600
75	2,586,200	1,172,000	216,730	3,968,100	2,761,500
70	2,967,700	1,386,900	235,400	4,356,800	3,204,500
65	3,345,800	1,469,200	288,550	5,497,500	3,427,500
60	3,694,600	1,629,100	311,450	6,007,800	3,849,600
55	4,061,700	1,822,000	322,540	6,397,000	4,377,400
50	4,428,700	1,993,300	380,720	6,953,900	4,593,200
45	4,825,800	2,167,900	407,110	7,462,600	5,187,100
40	5,219,400	2,300,700	440,220	8,377,600	5,551,000
35	5,655,700	2,607,500	475,230	8,226,700	6,233,500
30	6,124,400	2,915,100	450,800	8,519,100	6,983,500
25	6,659,500	3,193,000	477,210	9,116,700	7,683,100
20	7,295,400	3,554,200	532,840	9,664,600	8,366,500
15	8,040,800	3,752,700	596,930	11,906,000	8,838,100
10	9,169,900	4,307,200	693,300	13,108,000	10,324,000
8	9,719,000	4,598,800	732,080	13,718,000	10,943,000
6	10,404,000	4,957,200	765,010	14,446,000	11,866,000
5	10,910,000	5,468,800	752,740	13,175,000	13,173,000
4	11,440,000	5,389,300	883,820	15,801,000	13,239,000
2	13,041,000	6,508,500	899,820	16,234,000	15,420,000
1	14,592,000	7,213,500	988,530	18,134,000	17,779,000
0.1	21,278,000	11,993,000	898,760	16,092,000	31,040,000
0.01	24,420,000	14,241,000	691,800	12,543,000	40,772,000
0.001	26,161,000	13,163,000	1,413,000	31,032,000	34,077,000

Table 5. Assessment results by commodity for Chukchi Sea play 1, 2006 assessment.

Basin: CHUKCHI SEA SHELF
Play 01 - Endicott - Chukchi Platform
UAI Key: AAAAADAB

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	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0		0.000000	0.000000	0.000000	0.000000
5	0.5	1	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0		0.000000	0.000000	0.000000	0.000000
6	1	2	2	0.0023	0.0002	0.000222		2	0	0	1	1	0	0	0	0	1	1		1.825274	1.825274	3.650548	1.825274
7	2	4	7	0.008049	0.0007	0.000778		2	1	4	1	1	1	1	1	1	1	1		2.430906	3.962068	23.507490	3.358213
8	4	8	74	0.085094	0.0074	0.008225		39	16	19	1	2	1	1	1	1	1	2		4.034626	7.940021	460.341725	6.220834
9	8	16	375	0.431218	0.0375	0.041681		185	95	95	1	2	1	2	1	1	1	2		8.097361	15.981168	4649.873000	12.399660
10	16	32	1583	1.820314	0.1583	0.175948		867	358	358	1	3	1	2	1	2	1	3		16.020632	31.996125	39316.499000	24.836702
11	32	64	5375	6.180789	0.5375	0.597421		3051	1112	1212	1	4	1	3	1	3	1	7		32.016015	63.998066	262175.013000	48.776745
12	64	128	11803	13.572439	1.1803	1.311882		6923	2359	2521	1	7	1	5	1	4	1	10		64.021695	127.990498	1131071.000000	95.829086
13	128	256	18398	21.156124	1.8398	2.044904		11075	3427	3896	1	8	1	4	1	4	1	10		128.011315	255.997959	3438179.000000	186.877853
14	256	512	20194	23.221371	2.0194	2.244526		12250	3941	4003	1	10	1	5	1	4	1	15		256.022950	511.946244	7475528.000000	370.185608
15	512	1024	16534	19.012684	1.6534	1.837724		10241	3137	3156	1	7	1	4	1	4	1	9		512.035364	1023.989000	11943015.000000	722.330688
16	1024	2048	9084	10.445822	0.9084	1.00967		5570	1914	1600	1	6	1	3	1	4	1	8		1024.091000	2047.409000	12727864.000000	1.401130
17	2048	4096	2963	3.407196	0.2963	0.329332		1864	688	411	1	4	1	3	1	2	1	4		2048.248000	4090.209000	8017036.000000	2.705716
18	4096	8192	522	0.600255	0.0522	0.058019		290	167	65	1	2	1	2	1	1	1	3		4098.345000	8103.422000	2752940.000000	5.273832
19	8192	16384	49	0.056346	0.0049	0.005446		25	20	4	1	1	1	1	1	1	1	1		8249.180000	16286.426000	495629.716000	10.114893
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									Below Class	0.000000	0.000000	0.000000	0.000000
	Totals		**86963**	**100.000008**	**8.696301**	**9.665778**	Above Class	0	0	0									Above Class	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: 8997

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 1, 2006 assessment.

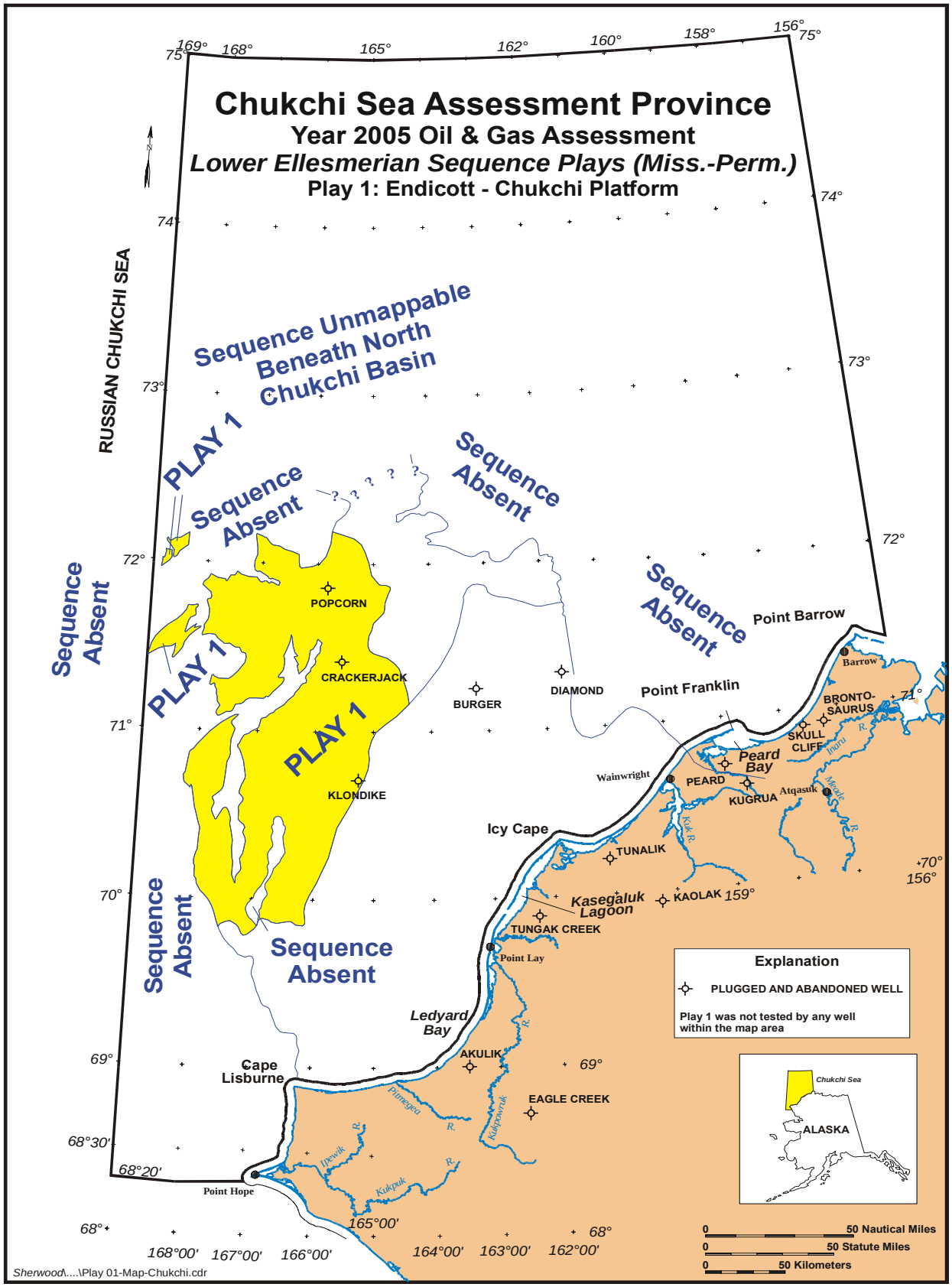

Figure 1. Map location of Chukchi Sea play 1, 2006 assessment.