Chukchi Sea Play 23: Northeast Chukchi Basin—Franklinian

Geological Assessment

GRASP UAI: AAAAA DAX
Play Area: 10,269 square miles
Play Water Depth Range: 110-200 feet
Play Depth Range: 3,000-20,000 feet
Play Exploration Chance: 0.12096

Play 23, Northeast Chukchi Basin-Franklinian, 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	332	1,360
Total Gas (Tcfg)	0.000	1.277	5.081
Total Liquids (Mmbo)	0	105	456
Free Gas** (Tcfg)	0.000	1.219	4.814
Solution Gas (Tcfg)	0.000	0.058	0.267
Oil (Mmbo)	0	39	180
Condensate (Mmbc)	0	66	276

** 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 23, the "Northeast Chukchi Basin—Franklinian" play, is the 15th-ranking play (of 29 plays) in the Chukchi Sea OCS Planning Area, with 1.1% (332 Mmboe) of the Planning Area energy endowment (29,041 Mmboe). The overall assessment results for play 23 are shown in table 1. Oil and gas-condensate liquids form 32% of the hydrocarbon energy endowment of play 23. Table 5 reports the detailed assessment results by commodity for play 23.

Table 3 summarizes the volumetric input data developed for the *GRASP* computer model of Chukchi Sea play 23. Table 4 reports the risk model used for play 23. The location of play 23 is shown in figure 1.

Play 23 includes probable carbonates of lower Paleozoic to Precambrian age and overlying slope-deposited (seismically clinoformal) clastic rocks (sandstones and shales), probably Devonian in age. These rocks occur in a fault-bounded relict of a basin beneath the northeast parts of Chukchi shelf. This structurally-isolated feature is termed the "Northeast Chukchi basin". Within Northeast Chukchi "basin", seismic records show a stratified sequence at least 30,000 feet in aggregate thickness. These rocks are coherently deformed, and seismic data identify a northwest-vergent thrust complex that overlies a southeast-dipping but undeformed subthrust sequence. The subthrust sequence contains the inferred Lower Paleozoic carbonates, which are approximately 15,000 feet thick. Elsewhere beneath Chukchi shelf, Franklinian rocks (or at least pre-Ellesmerian rocks) are seismically transparent or featureless in seismic records) and are inferred to be very complexly deformed and to offer little potential for hydrocarbons. An analog for oil and gas in Northeast Chukchi basin may be the oil pools found in folded Devonian rocks, the oils apparently sourced from organic-rich Cape Phillips shales of Silurian age, that are known from possibly correlative sequences in the Franklinian basin of the Canadian Arctic Islands. In

Northeast Chukchi basin, potential hydrocarbon traps are recognized as anticlines and thrust-faulted anticlines involving the clastic sequence in the central part of the play area and normal-fault truncations of dipping strata of the older carbonate sequence in the northwest parts of the play area. The rocks of play 23 play have not been tested anywhere by wells nor are they observed in outcrop. The Northeast Chukchi basin is known only from seismic reflection data.

Play 23, Northeast Chukchi Basin-Franklinian, 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	34	335	901
2	13	142	410
3	8	83	238
4	6	55	164
5	5	41	121
6	4.0	32	96
7	3.6	27	80
8	3.2	24	70
9	3.0	21	63
10	2.8	20	59

** 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 32 hypothetical pools is forecast by the aggregation of the risk model and the prospect numbers model for play 23. These 32 pools range in mean conditional (un-risked) recoverable volumes from 4 Mmboe (pool rank 32) to 335 Mmboe (pool rank 1). Pool rank 1 ranges in possible conditional recoverable volumes from 34 Mmboe (F95) to 901 Mmboe (F05). Table 2 shows the conditional sizes of the 10 largest pools in play 23.

In the computer simulation for play 23 a total of 27,266 "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 (5,018, or 18%) of simulation pools (conditional, technically recoverable BOE resources) for play 23. Pool size class 12 ranges from 64 to 128 Mmboe. The largest 13 simulation pools for play 23 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 23.

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

Basin: Chukchi Sea Planning Area
Play Number: 23
Play UAI Number: AAAAA DAX

Assessor: K.W. Sherwood
Play Name: Northeast Chukchi Basin (Franklinian)

Date: January 2005

Play Area: mi² (million acres) 10,269 (6.572)
Reservoir Thermal Maturity: % Ro 0.49 - 10.0?

Play Depth Range: feet 3,000 - 20,000 (mean = 10,000)
Expected Oil Gravity: ° API 25
Play Water Depth Range: feet 110 - 200 (mean = 150)

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*	9700		10145		74002	246228/781398			539830				871600
Prospect Area (acres)-Model Output**	9726	13481	17739	33311	81660	149209/172392	191927	298493	390374	550489			866895
Fill Fraction (Fraction of Area Filled)	0.04	0.07	0.08	0.09	0.10	0.11/0.02	0.12	0.13	0.14	0.15			0.23
Productive Area of Pool (acres)***	620	1316	1808	3398	8323	15817/19271	19935	31369	41153	58171	69000	74000	149544
Pay Thickness (feet)	31	63	70	81	100	106/34	130	140	150	160	170	185	300

* 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	0.56
Output Play Level Chance*	0.5512

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

Prospect Level Chance	0.216	Exploration Chance	0.12096

Risk Model	Play Chance	Petroleum System Factors	Prospect Chance
	0.7	Reservoir Presence (unknown)	
		Chance Porosity > 10%	0.3
	0.8	Source Presence (unknown)	
		Migration	0.9
		Preservation (risk of heating and conversion to asphalts)	0.8

Fractile	F99	F95	F90	F75	F50	Mean/Std. Dev.	F25	F15	F10	F05	F02	F01	F00
Numbers of Prospects in Play	8	11	13	16	20	22.52/9.25	26	30	33	38	44	49	90
Numbers of Pools in Play					2	2.72/3.19	5	6	7	9	11	12	32

Zero Pools at F55.14

Minimum Number of Pools	1 (F55)	Mean Number of Pools	2.72	Maximum Number of Pools	32

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	43	49	61	82	97/55	116	141	161	202	250	290	665
Gas Recovery Factor (Mcfg/acre-foot)	4	103	130	178	250	286/162	350	430	490	598	700	800	1592
Gas Oil Ratio (Sol'n Gas)(cf/bbl)	210	1000	1100	1250	1500	1483/361	1700	1850	1900	2050	2170	2250	2800
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)= 10.900 σ² (sigma squared)= 1.812
Random Number Generator Seed= 082776

BOE Conversion Factor (cf/bbl)	5620	Probability Any Pool Contains Both Oil and Free Gas (Gas Cap)	0.3
Probability Any Pool is 100% Oil	0	Fraction of Pool Volume Gas-Bearing in Oil Pools with Gas Cap	0.7
Probability Any Pool is 100% Gas	0.7		

Table 3. Input data for Chukchi Sea play 23, 2006 assessment.

Risk Analysis Form - 2006 National Assessment

Assessment Province:	Chukchi Sea OCS Planning Area	**Play Number, Name:**	23. Northeast Chukchi Basin - Franklinian
Assessor(s):	K.W. Sherwood	**Play UAI:**	AAAAA DAX
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**	***0.8000***	***0.7200***
	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	0.80	1.00
	b. Effective Expulsion and Migration			
	Probability of effective expulsion and migration of hydrocarbons from the source rock to the reservoirs.	1b	1.00	0.90
	c. Preservation			
	Probability of effective retention of hydrocarbons in the prospects after accumulation.	1c	1.00	0.80
2.	**Reservoir component** (2a * 2b)	**2**	***0.7000***	***0.3000***
	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	0.70	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	0.30
3.	**Trap component** (3a * 3b)	**3**	***1.0000***	***1.0000***
	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	1.00
	Overall Play Chance (Marginal Probability of hydrocarbons, MPhc)		***0.5600***	
	(1 * 2 * 3) *Product of All Subjective Play Chance Factors*			
	Average Conditional Prospect Chance[1]			***0.2160***
	(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		***0.1210***	
	(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 23, 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:	**AAAAADAX**		**Play No.**		**23**		
World	Level	-	World	Level		Resources	
Country	Level	-	UNITED	STATES		OF	AMERICA
Region	Level	-	MMS	-		ALASKA	REGION
Basin	Level	-	**CHUKCHI**	**SEA**		**SHELF**	
Play	**Level**	**-**	**Play**		**23**	**Northeast Chukchi Basin - Franklinian**	
Geologist	Kirk	W.	Sherwood				
Remarks	2005	Assessment					
Run Date & Time:		Date	19-Sep-05	Time		13:56:47	

Summary of Play Potential

Product	MEAN	Standard Deviation
BOE (Mboe)	332,490	499,830
Oil (Mbo)	39,435	94,072
Condensate (Mbc)	65,882	104,190
Free (Gas Cap & Nonassociated) Gas (Mmcfg)	1,218,700	1,856,800
Solution Gas (Mmcfg)	57,981	135,240

10000 (Number of Trials in Sample)

0.5512 (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	5,401	572	1,022	20,615	780
50	88,886	10,087	16,851	332,650	15,497
45	163,640	20,813	30,960	598,110	30,607
40	238,800	27,031	48,086	879,810	40,068
35	317,460	34,496	61,538	1,194,300	50,106
30	407,990	43,174	81,891	1,530,900	59,105
25	517,920	57,677	102,070	1,931,600	81,323
20	633,920	79,365	123,560	2,307,300	114,880
15	776,680	91,347	153,390	2,848,600	140,930
10	990,740	122,440	195,600	3,607,100	173,450
8	1,110,400	126,840	223,840	4,078,600	191,160
6	1,257,800	151,180	250,350	4,579,000	233,060
5	1,360,200	180,300	275,700	4,814,300	267,130
4	1,461,500	166,660	296,590	5,361,300	248,990
2	1,812,200	198,440	372,560	6,681,000	294,750
1	2,240,200	281,110	447,230	8,109,600	387,130
0.1	3,380,200	227,100	670,370	13,592,000	360,670
0.01	4,052,400	411,920	623,940	16,366,000	586,810
0.001	4,462,000	232,330	955,720	18,037,000	362,320

Table 5. Assessment results by commodity for Chukchi Sea play 23, 2006 assessment.

Basin: CHUKCHI SEA SHELF
Play 23 - Franklinian-Northeast Chukchi Basin
UAI Key: AAAAADAX

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	2	0.007335	0.0002	0.000363		0	0	2	0	0	0	0	1	1	1	1		0.079463	0.087604	0.167066	83.533101
3	0.125	0.25	3	0.011003	0.0003	0.000544		0	0	3	0	0	0	0	1	1	1	1		0.160126	0.228437	0.577786	192.595407
4	0.25	0.5	18	0.066016	0.0018	0.003265		0	0	18	0	0	0	0	1	1	1	1		0.271080	0.496166	7.367975	409.331918
5	0.5	1	55	0.201716	0.0055	0.009976		0	0	55	0	0	0	0	1	1	1	1		0.503196	0.999421	41.699363	758.170247
6	1	2	141	0.517128	0.0141	0.025576		7	0	134	1	1	0	0	1	2	1	2		1.009952	1.993750	218.378672	1.548785
7	2	4	481	1.764102	0.0481	0.087248		59	0	422	1	1	0	0	1	2	1	2		2.000076	3.999514	1501.443000	3.121503
8	4	8	1532	5.618719	0.1532	0.277889		319	0	1213	1	2	0	0	1	5	1	5		4.001880	7.995400	9397.283000	6.133997
9	8	16	3121	11.44649	0.3121	0.566116		812	0	2309	1	3	0	0	1	5	1	6		8.000200	15.999814	37154.248000	11.904597
10	16	32	4372	16.034622	0.4372	0.793035		1241	0	3131	1	4	0	0	1	6	1	8		16.001670	31.999342	102303.697000	23.399748
11	32	64	4935	18.099464	0.4935	0.895157		1534	0	3401	1	4	0	0	1	6	1	7		32.006814	63.979405	227815.621000	46.163246
12	64	128	5018	18.403873	0.5018	0.910212		1607	0	3411	1	6	0	0	1	5	1	8		64.002574	127.977537	461786.680000	92.026039
13	128	256	4070	14.927015	0.407	0.738255		1378	0	2692	1	4	0	0	1	5	1	7		128.011896	255.989397	740033.219000	181.826340
14	256	512	2433	8.923201	0.2433	0.441321		840	0	1593	1	3	0	0	1	5	1	5		256.004206	511.864661	865427.810000	355.703979
15	512	1024	892	3.271474	0.0892	0.161799		308	0	584	1	2	0	0	1	2	1	3		512.007889	1022.102000	608369.396000	682.028442
16	1024	2048	180	0.660163	0.018	0.03265		74	0	106	1	1	0	0	1	2	1	2		1032.836000	2027.022000	239042.824000	1.328016
17	2048	4096	13	0.047678	0.0013	0.002358		6	0	7	1	1	0	0	1	1	1	1		2101.564000	3037.825000	31772.589000	2.444045
18	4096	8192	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0		0.000000	0.000000	0.000000	0.000000
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									Below Class	0.000000	0.000000	0.000000	0.000000
		Totals	**27266**	**100.000008**	**2.7266**	**4.945764**	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: 5513

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 23, 2006 assessment.

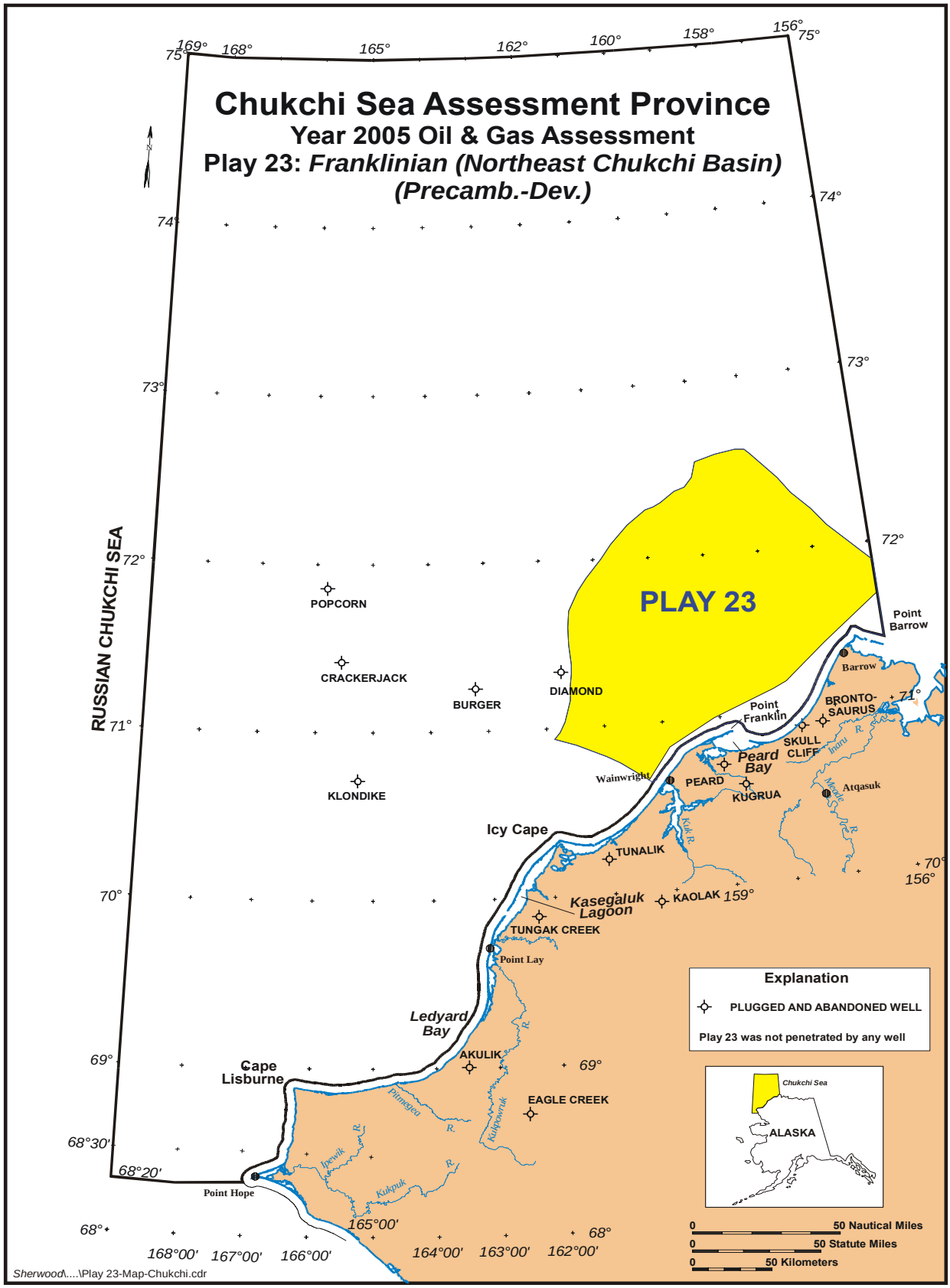

Figure 1. Map location of Chukchi Sea play 23, 2006 assessment.