Chukchi Sea Play 26: Late Sequence (Oligocene-Pliocene)-Hope Basin

Correlative to Hope Basin Play 1

Geological Assessment

GRASP UAI: AAAAA DBA
Play Area: 4,230 square miles
Play Water Depth Range: 50-180 feet
Play Depth Range: 1,000-8,000 feet
Play Exploration Chance: 0.0768

Play 26, Late Sequence (Oligocene-Pliocene)-Hope Basin, 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	132	617
Total Gas (Tcfg)	0.000	0.596	2.730
Total Liquids (Mmbo)	0	26	132
Free Gas** (Tcfg)	0.000	0.588	2.685
Solution Gas (Tcfg)	0.000	0.008	0.045
Oil (Mmbo)	0	11	64
Condensate (Mmbc)	0	15	68
* 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 26, the "Late Sequence (Oligocene-Pliocene)-Hope Basin" play, is the 20th-ranking play (of 29 plays) in the Chukchi Sea OCS Planning Area, with 0.5% (132 Mmboe) of the Planning Area energy endowment (29,041 Mmboe). The overall assessment results for play 26 are shown in table 1. Oil and gas-condensate liquids form 20% of the hydrocarbon energy endowment of play 26. Table 5 reports the detailed assessment results by commodity for play 26.

Table 3 summarizes the volumetric input data developed for the *GRASP* computer model of Chukchi Sea play 26. Table 4 reports the risk model used for play 26. The location of play 26 is shown in figure 1.

Play 26 includes all Oligocene(?) and younger strata in the Hope basin part of the Chukchi Sea Planning Area. Shallow shelf or fluvio-deltaic sandstones form the most likely reservoir rocks. Two exploratory wells drilled in Kotzebue basin indicate that the sandstones in the Late Sequence play are highly porous. Organic material in well samples is cellulosic (woody) with hydrogen indices generally below 200 mgHC[1]/gTOC[2], indicating that any hydrocarbons generated upon burial and heating would probably be gas. Total organic carbon values average over 1.0 percent, but higher values are associated with coals[3] and are confined to the upper, thermally immature part of the sequence. The coals may form sources for biogenic (bacterial) gas. Only very small volumes of this sequence, in the very deepest parts of the basins, achieve thermal maturity appropriate for thermogenic creation of petroleum (Ro>0.6%).

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[1]**HC**, *hydrocarbon matter evolved from samples during heating (pyrolysis) experiments.*

[2]**TOC***, total organic carbon*

[3]*therefore not indicative of any significant petroleum source potential*

Therefore, hydrocarbons would have to migrate into Late Sequence prospects from thermally mature sources among older Tertiary (Eocene) rocks near the floor of the basin in the area where these rocks reach depths greater than 7,300 ft subsea (corresponds to 0.6% Ro isograd). Traps within the Late Sequence play were formed during a second stage of widespread basin faulting, probably in Miocene(?) time, well before the deepest sediments in the basins reached thermal maturity, the latter probably occurring in Pliocene or Pleistocene time. Outside of the thermally-mature area, prospects must be charged primarily by biogenic methane. Rocks correlative to play 26 were penetrated by the Cape Espenberg and Nimiuk Point wells in Kotzebure Sound.

Play 26, Late Sequence (Hope Basin), 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	31	182	478
2	14	82	206
3	9	51	124
4	6	37	89
5	5	28	68
6	4.3	23	55
7	3.8	20	46
8	3.4	17	40
9	3.0	15	36
10	2.7	14	32
* 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 17 hypothetical pools is forecast by the aggregation of the risk model and the prospect numbers model for play 26. These 17 pools range in mean conditional (un-risked) recoverable volumes from 8 Mmboe (pool rank 17) to 182 Mmboe (pool rank 1). Pool rank 1 ranges in possible conditional recoverable volumes from 31 Mmboe (F95) to 478 Mmboe (F05). Table 2 shows the conditional sizes of the 10 largest pools in play 26.

In the computer simulation for play 26 a total of 15,953 "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 (3,990, or 25%) of simulation pools (conditional, technically recoverable BOE resources) for play 26. Pool size class 11 ranges from 32 to 64 Mmboe. The largest 18 simulation pools for play 26 fall within pool size class 16, which ranges in size from 1,024 to 2,048 Mmboe. Table 6 reports statistics for the simulation pools developed in the *GRASP* computer model for play 26.

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

Basin: Chukchi Sea Planning Area   **Assessor**: K.W. Sherwood   **Date**: January 2005
Play Number: 26   **Play Name**: Late Sequence (Oligocene-Pliocene) - Hope Basin
Play UAI Number: AAAAA DBA

Play Area: mi^2 (million acres)   4,230 (2.707)   **Play Depth Range**: feet   1,000 - 8,000 (mean = 5,000)
Reservoir Thermal Maturity: % Ro   0.20 - 0.60   **Expected Oil Gravity**: $^\circ$ API   40
Play Water Depth Range: feet   50 - 180 (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*	2760		3992		10832	14670/13399			29389				77090
Prospect Area (acres)-Model Output**	2763	3754	4587	6986	11257	14606/11157	18475	24178	29199	37271			76925
Fill Fraction (Fraction of Area Filled)	0.05	0.09	0.10	0.12	0.15	0.16/0.05	0.18	0.21	0.22	0.25			0.50
Productive Area of Pool (acres)***	191	502	627	997	1692	2292/1955	2923	3841	4660	6211	7900	9100	22149
Pay Thickness (feet)	10	62	74	100	145	160/85	200	230	260	320	390	440	600

* 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		Prospect Level Chance	0.192		Exploration Chance	0.0768
Output Play Level Chance*	0.3934						

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

Risk Model	Play Chance	Petroleum System Factors	Prospect Chance
		Seal Integrity (sandy, shallow, faulted sequence)	0.6
		Reservoir Presence (mostly sag-phase mudrocks?)	0.8
	0.5	Source Presence (unknown)	
	0.8	Source Maturity (generative volume limited to very small part of basin)	
		Migration (mostly vertical up faults; risk of diversion to surface and no access for much of basin away from generation area)	0.4

Fractile	F99	F95	F90	F75	F50	Mean/Std. Dev.	F25	F15	F10	F05	F02	F01	F00
Numbers of Prospects in Play	13	15	16	17	20	20.78/3.90	23	24	25	27	28	31	39
Numbers of Pools in Play						1.60/2.31	3	4	5	6	7	8	17

Zero Pools at F39.36

Minimum Number of Pools	2 (F35)		Mean Number of Pools	1.6		Maximum Number of Pools	17

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	131	162	229	325	353/168	446	519	576	665	740	800	1320
Gas Recovery Factor (Mcfg/acre-foot)	159	461	564	741	986	1029/390	1272	1427	1550	1730	1800	1900	2779
Gas Oil Ratio (Sol'n Gas)(cf/bbl)	400	610	640	690	750	748/99	810	845	865	900	930	955	1100
Condensate Yield ((bbl/Mmcfg)	13	18	19	22	25	25/5	28	30	31	33	36	38	50

Pool Size Distribution Statistics from *POOLS* (1,000 BOE): μ (mu)= 10.776 σ^2 (sigma squared)= 1.138   Random Number Generator Seed= 203252

BOE Conversion Factor (cf/bbl)	5620	Probability Any Pool Contains Both Oil and Free Gas (Gas Cap)	0.1
Probability Any Pool is 100% Oil	0	Fraction of Pool Volume Gas-Bearing in Oil Pools with Gas Cap	0.5
Probability Any Pool is 100% Gas	0.9		

Table 3. Input data for Chukchi Sea play 26, 2006 assessment.

Risk Analysis Form - 2006 National Assessment

Assessment Province:	Chukchi Sea OCS Planning Area
Play Number, Name:	26. Late Sequence (Oligocene-Pliocene) - Hope Basin
Assessor(s):	K.W. Sherwood
Play UAI:	AAAAA DBA
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	*0.4000*	*0.4000*
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	0.40	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	0.40
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*	*0.8000*
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	0.80
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	1.00
3. Trap component (3a * 3b)		3	*1.0000*	*0.6000*
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	0.60

Overall Play Chance (Marginal Probability of hydrocarbons, MPhc)	*0.4000*	
(1 * 2 * 3) *Product of All Subjective Play Chance Factors*		

Average Conditional Prospect Chance[1]		*0.1920*
(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	*0.0768*
(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

1a: 0.5 (Source Presence) X 0.8 (Maturation) = 0.40

Table 4. Risk model for Chukchi Sea play 26, 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: AAAAADBA			**Play No.**		**26**		
World	Level	-	World	Level	Resources		
Country	Level	-	UNITED	STATES	OF		AMERICA
Region	Level	-	MMS	-	ALASKA	REGION	
Basin	Level	-	**CHUKCHI**	**SEA**	**SHELF**		
Play	**Level**	**-**	**Play**		**26 Late Sequence (Oligocene-Piocene)**		
Geologist	Kirk	W.	Sherwood		**- Hope Basin**		
Remarks		2005 Assessment			(Correlative to Hope Basin Play 01)		
Run Date & Time:		Date	19-Sep-05 Time		13:57:22		

Summary of Play Potential

Product	MEAN	Standard Deviation
BOE (Mboe)	132,030	234,670
Oil (Mbo)	11,185	46,346
Condensate (Mbc)	14,770	26,531
Free (Gas Cap & Nonassociated) Gas (Mmcfg)	587,870	1,049,500
Solution Gas (Mmcfg)	8,280	35,153

10000 (Number of Trials in Sample)
0.3934 (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	0	0	0	0	0
35	75,688	3,742	8,714	352,610	2,758
30	137,150	5,578	16,528	642,290	4,244
25	201,560	15,336	22,856	906,690	11,432
20	267,690	15,745	30,693	1,231,200	12,191
15	342,670	28,703	38,746	1,527,300	19,461
10	442,770	29,971	50,372	2,014,700	22,144
8	501,510	33,737	57,374	2,280,600	25,843
6	574,500	45,166	64,827	2,578,100	32,430
5	617,480	63,723	67,978	2,684,900	45,142
4	674,830	81,432	72,133	2,870,400	59,048
2	862,760	71,119	98,133	3,843,600	53,892
1	1,034,900	111,570	111,980	4,477,500	82,336
0.1	1,590,900	81,945	189,060	7,359,600	58,045
0.01	2,018,200	1,438,400	55,120	1,895,900	1,052,900
0.001	2,097,500	1,153,600	84,362	3,764,500	1,066,200

Table 5. Assessment results by commodity for Chukchi Sea play 26, 2006 assessment.

Basin: CHUKCHI SEA SHELF
Play 26 - Hope - Late Sequence (HB Play 1)
UAI Key: AAAAADBA

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	1	0.006268	0.0001	0.000254		0	0	1	0	0	0	0	1	1	1	1		0.291792	0.291792	0.291792	291.792363
5	0.5	1	8	0.050147	0.0008	0.002033		1	0	7	1	1	0	0	1	1	1	1		0.591059	0.974671	6.343258	792.907178
6	1	2	50	0.313421	0.005	0.012706		2	0	48	1	1	0	0	1	1	1	1		1.007012	1.987609	77.742597	1.554852
7	2	4	176	1.103241	0.0176	0.044727		9	0	167	1	1	0	0	1	2	1	2		2.031951	3.994963	548.267973	3.115159
8	4	8	569	3.566727	0.0569	0.1446		25	0	544	1	1	0	0	1	3	1	3		4.001284	7.996491	3452.635000	6.067899
9	8	16	1628	10.204977	0.1628	0.413723		101	0	1527	1	2	0	0	1	5	1	5		8.006006	15.994768	19786.522000	12.153883
10	16	32	3035	19.024635	0.3035	0.771283		243	0	2792	1	2	0	0	1	6	1	6		16.000272	31.996101	71915.208000	23.695292
11	32	64	3990	25.010969	0.399	1.013977		401	0	3589	1	3	0	0	1	6	1	6		32.000053	63.990354	183991.985000	46.113281
12	64	128	3618	22.679119	0.3618	0.919441		408	0	3210	1	2	0	0	1	5	1	6		64.001595	127.934538	326701.707000	90.298981
13	128	256	2031	12.731148	0.2031	0.516137		325	0	1706	1	2	0	0	1	4	1	4		128.014283	255.889660	356172.769000	175.368179
14	256	512	675	4.231179	0.0675	0.171537		124	0	551	1	2	0	0	1	4	1	4		256.024360	511.175671	234126.322000	346.853821
15	512	1024	154	0.965336	0.0154	0.039136		31	0	123	1	1	0	0	1	2	1	2		514.672066	1023.274000	101302.181000	657.806396
16	1024	2048	18	0.112831	0.0018	0.004574		6	0	12	1	1	0	0	1	1	1	1		1028.743000	1622.458000	22237.230000	1.235402
17	2048	4096	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0		0.000000	0.000000	0.000000	0.000000
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		15953	99.999992	1.5953	4.05413	Above Class	0	0	0									Above Class	0.000000	0.000000	0.000000	0.000000

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 not Classified: 0
Number of Pools below Class 1: 0
Number of Trials with Pools: 3935

Table 6. Statistics for simulation pools created in computer sampling run for Chukchi Sea play 26, 2006 assessment.
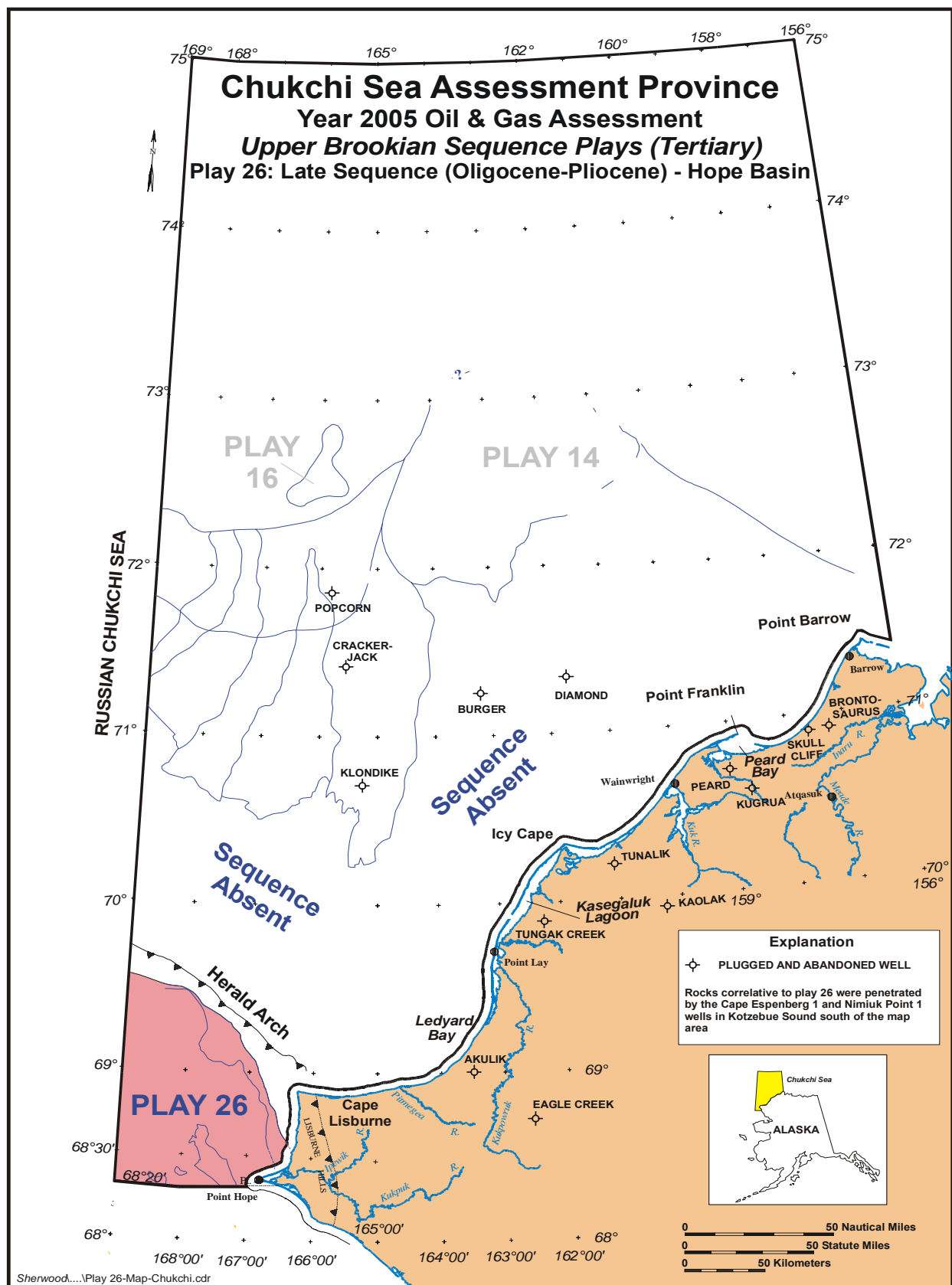
Figure 1. Map location of Chukchi Sea play 26, 2006 assessment.