

Chukchi Sea Play 28: Shallow (<10,000 ft) Basal Sandstones-Hope Basin

Correlative to Hope Basin Play 3

Geological Assessment

GRASP UAI: AAAAA DBC

Play Area: 3,979 square miles

Play Water Depth Range: 30-180 feet

Play Depth Range: 1,000-10,000 feet

Play Exploration Chance: 0.04704

Play 28, Shallow (<10,000 ft) Basal Sandstones-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	72	301
Total Gas (Tcfg)	0.000	0.335	1.388
Total Liquids (Mmbo)	0	13	54
Free Gas** (Tcfg)	0.000	0.331	1.370
Solution Gas (Tcfg)	0.000	0.004	0.018
Oil (Mmbo)	0	4	19
Condensate (Mmbc)	0	8	34
* 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 28, the “Shallow (<10,000 ft) Basal Sandstones-Hope Basin” play, is the 25th-ranking play (of 29 plays) in the Chukchi Sea OCS Planning Area, with 0.2% (72 Mmboe) of the Planning Area energy endowment (29,041 Mmboe). The overall assessment results for play 28 are shown in

table 1. Oil and gas-condensate liquids form 18% of the hydrocarbon energy endowment of play 28. Table 5 reports the detailed assessment results by commodity for play 28.

Table 3 summarizes the volumetric input data developed for the GRASP computer model of Chukchi Sea play 28. Table 4 reports the risk model used for play 28. The location of play 28 is shown in figure 1.

Plays 28 and 29 were defined to acknowledge the possible existence of sandstones (presence inferred by analogy to Norton basin) creating potential traps at the base of the sedimentary fill of Hope and Kotzebue basins. The two plays are separated at a burial depth of 10,000 feet. Density log porosities of sandstones in the Kotzebue basin wells are projected¹ to fall below 10 percent at burial depths greater than 10,000 feet. Because most types of sandstones cannot house extractable petroleum when porosities fall below 10 percent, the model reflects our view that it is improbable that viable (sufficiently porous and permeable) sandstone reservoirs were preserved in the Deep Basal Sand (29) play. Potential source rocks for prospects in plays 28 and 29 would include the gas-prone organic material detected in Early Sequence samples in the two Kotzebue basin wells. Other petroleum sources of a speculative nature might include older, un-sampled rocks in the deeper parts of Hope basin, or basement rocks. Play 28 lies partly within

¹extrapolated below well data using a Norton basin porosity decline rate (based on data presented by Turner and others, 1986, fig. 24)

the zone of thermally mature strata in the deepest part of the basin and there would have access to thermogenic methane expelled from Tertiary rocks near the basin floor. Play 28 also extends across submature areas northward to the limit of Hope basin strata. In the submature area, play 28 would only have access to biogenic methane.

In the computer simulation for play 28 a total of 26,544 “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 (7,065, or 27%) of simulation pools (conditional, technically recoverable BOE resources) for play 28. Pool size class 10 ranges from 16 to 32 Mmboe. The largest 5 simulation pools for play 28 fall within pool size class 15, which ranges in size from 512 to 1,024 Mmboe. [Table 6](#) reports statistics for the simulation pools developed in the *GRASP* computer model for play 28.

Play 28, Shallow (<10,000 ft) Basal Sandstones (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	19	76	202
2	10	38	81
3	6	26	54
4	4	19	40
5	3.2	15	32
6	2.6	12	26
7	2.2	10	22
8	1.9	9	19
9	1.7	8	17
10	1.6	7	15

* 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 25 hypothetical pools is forecast by the aggregation of the risk model and the prospect numbers model for play 28. These 25 pools range in mean conditional (un-risked) recoverable volumes from 2 Mmboe (pool rank 25) to 76 Mmboe (pool rank 1). Pool rank 1 ranges in possible conditional recoverable volumes from 19 Mmboe (F95) to 202 Mmboe (F05). [Table 2](#) shows the conditional sizes of the 10 largest pools in play 28.

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

Basin: Chukchi Sea Planning Area
Play Number: 28
Play UAI Number: AAAAA DBC

Assessor: K.W. Sherwood
Play Name: Shallow (<10,000 ft) Basal Sandstones - Hope Basin

Date: January 2005

Play Area: mi² (million acres) 3,979 (2.547)
Reservoir Thermal Maturity: % Ro 0.20 - 0.83

Play Depth Range: feet 1,000 - 10,000 (mean = 5,000)
Expected Oil Gravity: ° API 40
Play Water Depth Range: feet 30 - 180 (mean = 165)

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*	2102		4177		11278	15229/13820			30452				81770
Prospect Area (acres)-Model Output**	2103	3569	4522	7002	11624	15155/11839	19407	25213	30680	38907			80973
Fill Fraction (Fraction of Area Filled)	0.04	0.09	0.10	0.12	0.15	0.16/0.05	0.18	0.21	0.23	0.25			0.50
Productive Area of Pool (acres)***	144	480	620	1009	1742	2387/2166	3021	3999	4810	6391	8100	9500	23261
Pay Thickness (feet)	18	36	40	48	60	63/20	74	83	90	101	115	125	195

* 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	0.1176	Exploration Chance	0.04704
Output Play Level Chance*	0.399				

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

Risk Model	Play Chance	Petroleum System Factors	Prospect Chance
		Seal Integrity (traps highly faulted)	0.7
		Reservoir Presence (onknown)	0.8
		Chance Porosity > 10% (volcanics accelerate porosity loss)	0.6
	0.5	Source Presence (unknown)	
	0.8	Maturity of Source Rocks (small generation volume)	
		Migration (primarily vertical along faults; source beds possibly above reservoir sequence)	0.35

Fractile	F99	F95	F90	F75	F50	Mean/Std. Dev.	F25	F15	F10	F05	F02	F01	F00
Numbers of Prospects in Play	36	40	43	48	55	56.43/11.04	62	67	70	75	82	85	108
Numbers of Pools in Play						2.65/3.69	6	7	8	10	11	13	25

Zero Pools at F39.93

Minimum Number of Pools	4 (F35)	Mean Number of Pools	2.65	Maximum Number of Pools	25
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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)	29	74	95	135	193	211/105	267	314	346	404	460	500	836
Gas Recovery Factor (Mcf/acre-foot)	117	376	457	623	823	861/331	1061	1205	1308	1460	1600	1700	2546
Gas Oil Ratio (Sol'n Gas)(cf/bbl)	420	710	760	830	910	908/137	995	1040	1070	1120	1160	1190	1400
Condensate Yield ((bbl/Mmcf)	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)= 9.741 σ^2 (sigma squared)= 0.991 Random Number Generator Seed= 831570

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 28, 2006 assessment.

Risk Analysis Form - 2006 National Assessment			
Assessment Province:	Chukchi Sea OCS Planning Area	Play Number, Name:	28. Shallow (<10,000 ft) Basal Sandstones - Hope Basin
Assessor(s):	K.W. Sherwood	Play UAI:	AAAAA DBC
Date:	1-Jan-05		
For each component, a <i>quantitative</i> probability of success (i.e., between zero and one, where zero indicates no confidence and one indicates absolute certainty) based on consideration of the <i>qualitative</i> 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	Average Conditional Prospect Chance ¹
1. Hydrocarbon Fill component (1a * 1b * 1c)	1	0.4000	0.3500
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	0.35
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	0.4800
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	0.60
3. Trap component (3a * 3b)	3	1.0000	0.7000
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	0.70
Overall Play Chance (Marginal Probability of hydrocarbons, MP_{hc})		0.4000	
<i>(1 * 2 * 3) Product of All Subjective Play Chance Factors</i>			
Average Conditional Prospect Chance¹			0.1176
<i>(1 * 2 * 3) Product of All Subjective Conditional Prospect Chance Factors</i>			
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		0.0470	
<i>(Product of Overall Play Chance and Average Conditional Prospect Chance)</i>			
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 28, 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: AAAAADC	Play No. 28
World Level -	World Level Resources
Country Level -	UNITED STATES OF AMERICA
Region Level -	MMS - ALASKA REGION
Basin Level -	CHUKCHI SEA SHELF
Play Level -	28 Shallow (<10,000 ft) Basal Sandstones - Hope Basin
Geologist Kirk W. Sherwood	(Correlative to Hope Basin Play 03)
Remarks 2005 Assessment	13:57:41
Run Date & Time: Date 19-Sep-05 Time	

Summary of Play Potential

Product	MEAN	Standard Deviation
BOE (Mboe)	72,274	113,460
Oil (Mbo)	4,341	14,131
Condensate (Mbc)	8,305	13,224
Free (Gas Cap & Nonassociated) Gas (Mmcf)	331,170	524,410
Solution Gas (Mmcf)	3,942	12,882

10000 (Number of Trials in Sample)
 0.399 (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 (Mmcf)	Solution Gas (Mmcf)
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	4,322	260	498	19,835	194
35	67,854	4,047	7,757	311,250	3,747
30	100,610	5,556	11,622	464,030	4,867
25	130,130	6,635	15,171	602,820	5,981
20	160,910	10,363	18,705	731,660	9,273
15	194,490	15,033	21,787	872,320	13,779
10	237,250	13,638	27,106	1,091,800	12,523
8	258,840	16,564	29,838	1,179,300	14,599
6	286,050	14,651	33,800	1,322,300	13,003
5	300,660	19,282	34,409	1,370,100	17,901
4	322,380	21,152	36,703	1,466,800	19,817
2	384,310	22,188	44,164	1,766,400	20,508
1	454,790	27,598	52,637	2,081,100	23,838
0.1	717,330	11,607	79,781	3,508,700	9,050
0.01	895,420	15,810	104,810	4,338,200	16,095
0.001	1,068,300	13,282	151,190	5,066,300	13,252

Table 5. Assessment results by commodity for Chukchi Sea play 28, 2006 assessment.

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	0	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	0	0.000000	0.000000
3	0.125	0.25	1	0.003767	0.0001	0.000251	0	0	1	0	0	0	0	1	1	1	1	1	1	0.163876	163.876012
4	0.25	0.5	14	0.052743	0.0014	0.003508	0	0	14	0	0	0	0	1	1	1	1	1	1	0.315124	409.924567
5	0.5	1	104	0.391802	0.0104	0.026059	5	0	99	1	1	0	0	1	3	1	3	3	3	0.501326	788.326740
6	1	2	486	1.830922	0.0486	0.121774	29	0	457	1	1	0	0	1	3	1	3	3	3	1.000179	1.542266
7	2	4	1480	5.575648	0.148	0.370834	94	0	1386	1	2	0	0	1	4	1	4	4	4	2.002329	3.060425
8	4	8	3752	14.135021	0.3752	0.940115	307	0	3445	1	2	0	0	1	6	1	6	6	6	4.005396	6.032311
9	8	16	6498	24.480108	0.6498	1.628163	600	0	5898	1	3	0	0	1	9	1	9	9	9	8.000084	11.716231
10	16	32	7065	26.616184	0.7065	1.770233	816	0	6249	1	3	0	0	1	8	1	8	8	8	16.000490	22.884951
11	32	64	4901	18.463682	0.4901	1.228013	577	0	4324	1	2	0	0	1	8	1	8	8	8	32.002668	44.431740
12	64	128	1812	6.826401	0.1812	0.454022	246	0	1566	1	2	0	0	1	4	1	4	4	4	64.007413	85.675766
13	128	256	362	1.363773	0.0362	0.090704	49	0	313	1	1	0	0	1	3	1	3	3	3	128.138168	165.851639
14	256	512	64	0.241109	0.0064	0.016036	8	0	56	1	1	0	0	1	2	1	2	2	2	256.279352	324.586548
15	512	1024	5	0.018837	0.0005	0.001253	0	0	5	0	0	0	0	1	1	1	1	1	1	527.996187	621.737610
16	1024	2048	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000
17	2048	4096	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000
18	4096	8192	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000
19	8192	16384	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000
20	16384	32768	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000
21	32768	65536	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000
22	65536	131072	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000
23	131072	262144	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000
24	262144	524288	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000
25	524288	1048576	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000
Not Classified			0	0	0	0	Below Class	0	0	0										Below Class	0.000000
			0	0	0	0	Above Class	0	0	0										Above Class	0.000000
Totals			26544	100	2.6544	6.650964															

Number of Pools not Classified: 0	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 below Class 1: 0		
Number of Trials with Pools: 3991		

Table 6. Statistics for simulation pools created in computer sampling run for Chukchi Sea play 28, 2006 assessment.

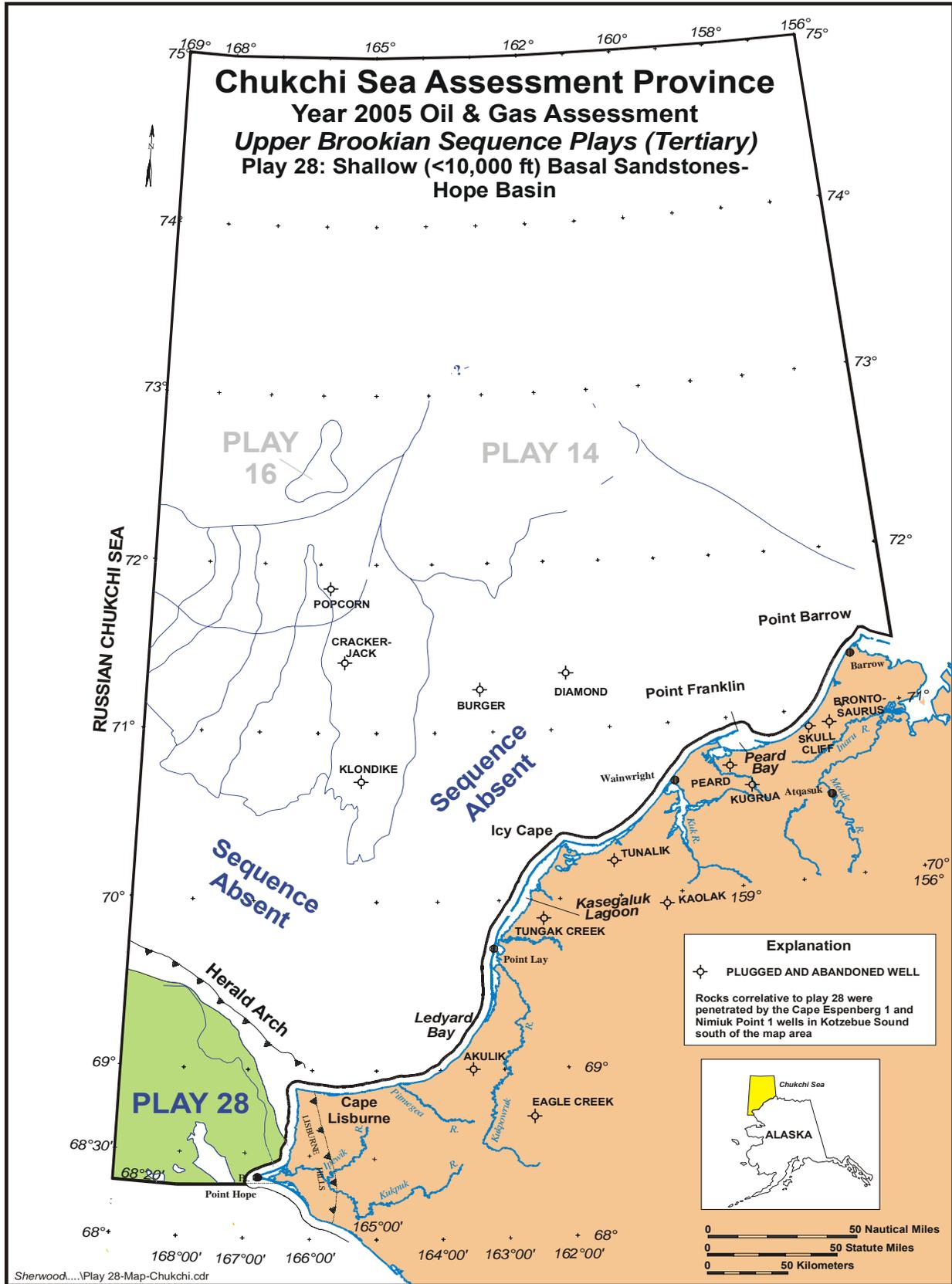


Figure 1. Map location of Chukchi Sea play 28, 2006 assessment.