

Chukchi Sea Play 19: Sag Sequence (Upper Brookian)-North Chukchi Basin

Geological Assessment

GRASP UAI: AAAAA DAT

Play Area: 10,567 square miles

Play Water Depth Range: 150-330 feet

Play Depth Range: 2,551-10,412 feet

Play Exploration Chance: 0.03375

Play 19, Sag Sequence (Upper Brookian)-North Chukchi 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	22	133
Total Gas (Tcfg)	0.000	0.058	0.376
Total Liquids (Mmbo)	0	12	67
Free Gas** (Tcfg)	0.000	0.050	0.334
Solution Gas (Tcfg)	0.000	0.007	0.041
Oil (Mmbo)	0	9	50
Condensate (Mmbc)	0	3	17
<i>* Risked, Technically-Recoverable</i> <i>** Free Gas Includes Gas Cap and Non-Associated Gas</i> <i>F95 = 95% chance that resources will equal or exceed the given quantity</i> <i>F05 = 5% chance that resources will equal or exceed the given quantity</i> <i>BOE = total hydrocarbon energy, expressed in barrels-of-oil-equivalent, where 1 barrel of oil = 5,620 cubic feet of natural gas</i> <i>Mmb = millions of barrels</i> <i>Tcf = trillions of cubic feet</i>			

Table 1

Play 19, the “Sag Sequence-North Chukchi Basin” play, is the 27th-ranking play (of 29 plays) in the Chukchi Sea OCS Planning Area, with 0.08% (22 Mmboe) of the Planning Area energy endowment (29,041 Mmboe). The overall assessment results of play 19 are shown in [table 1](#). Oil and gas-condensate liquids form 54% of the

hydrocarbon energy endowment of play 19.

[Table 5](#) reports the detailed assessment results by commodity for play 19.

[Table 3](#) summarizes the volumetric input data developed for the *GRASP* computer model of Chukchi Sea play 19. [Table 4](#) reports the risk model used for play 19. The location of play 19 is shown in [figure 1](#).

Potential reservoirs include Eocene and younger marine sandstones deposited in North Chukchi basin during the post-rift thermal or "sag" phase of basin subsidence. Some sandstones in this sequence may be associated with a late Eocene (and younger) regression now marked by an unconformity overlain by Late Oligocene to Miocene strata at 1,041 feet in Popcorn well and widely observed and mapped in seismic data in North Chukchi basin. Prospects include fault traps, faulted anticlines, and diapir-flank traps, the latter in a graben west of Popcorn well. This play is mostly charged by the North Chukchi basin play charging system. Play 19 was tested in a proximal setting by Popcorn well, which encountered only very sparse sandstone in the Eocene sequence (1,041 to 3,235 feet) but abundant sandstones in shallow, unlogged parts of the well above 1,300 feet. Reservoir presence is therefore considered a major risk element for this play.

A maximum of 17 hypothetical pools is forecast by the aggregation of the risk model and the prospect numbers model for play 19. These 17 pools range in mean conditional (un-risked) recoverable volumes from 2 Mmboe (pool rank 17) to 52 Mmboe (pool rank 1). Pool rank 1 ranges in possible conditional recoverable volumes from 7

Mmboe (F95) to 146 Mmboe (F05). [Table 2](#) shows the conditional sizes of the 10 largest pools in play 19.

Play 19, Sag Sequence (Upper Brookian)-North Chukchi 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	7	52	146
2	3	21	57
3	1.9	12	33
4	1.4	8	22
5	1.1	6	16
6	0.98	5.0	13
7	0.88	4.2	10
8	0.81	3.7	9
9	0.75	3.2	8
10	0.66	2.9	7
<p>* Conditional, Technically-Recoverable, Millions of Barrels Energy-Equivalent (Mmboe), from "PSRK.out" file</p> <p>F95 = 95% chance that resources will equal or exceed the given quantity</p> <p>F05 = 5% chance that resources will equal or exceed the given quantity</p> <p>BOE = total hydrocarbon energy, expressed in barrels-of-oil-equivalent, where 1 barrel of oil = 5,620 cubic feet of natural gas</p>			

Table 2

In the computer simulation for play 19 a total of 10,496 “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 9 contains the largest share (2,268, or 22%) of simulation pools (conditional, technically recoverable BOE resources) for play 19. Pool size class 9 ranges from 8 to 16 Mmboe. The largest 4 simulation pools for play 19 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 19.

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

Basin: Chukchi Sea Planning Area
Play Number: 19

Play UAI Number: AAAAA DAT

Assessor: K.W. Sherwood

Play Name: Sag Sequence Upper Brookian) - North Chukchi Basin

Date: January 2005

Play Area: mi² (million acres) 10,567 (6.763)
Reservoir Thermal Maturity: % Ro 0.36 - 0.78

Play Depth Range: feet 2,551 - 10,412 (mean = 5,425)
Expected Oil Gravity: ° API 35
Play Water Depth Range: feet 150 - 330 (mean = 170)

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*	896		1106		4492	8170/12412			18247				79479
Prospect Area (acres)-Model Output**	899	1206	1492	2491	4827	8195/9480	9895	14251	19020	27300			78997
Fill Fraction (Fraction of Area Filled)	0.09	0.18	0.19	0.22	0.25	0.26/0.05	0.29	0.31	0.32	0.35			0.60
Productive Area of Pool (acres)***	109	295	370	614	1209	2092/2496	2500	3692	4827	6769	8200	9800	27649
Pay Thickness (feet)	15	30	34	41	50	52/16	61	68	74	82	93	101	150

* 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	0.25
Output Play Level Chance*	0.2461

Prospect Level Chance	0.135
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Exploration Chance	0.03375
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* First Occurrence of Non Zero Pools As Reported in PSUM Module

Risk Model	Play Chance	Petroleum System Factors	Prospect Chance
	0.25	Timing (late-stage drape folds [Oligocene?] may post-date hydrocarbon generation and migration [Cretaceous-Eocene?])	
		Reservoir Presence (chiefly a marine pelagic mud environment)	0.3
		Chance Porosity > 10%	0.9
		Migration (underlying mud-dominated late-rift sequence may form a barrier to hydrocarbons rising from deeper source rocks)	0.5

Fractile	F99	F95	F90	F75	F50	Mean/Std. Dev.	F25	F15	F10	F05	F02	F01	F00
Numbers of Prospects in Play	20	22	24	27	30	31.12/5.75	33	37	39	41	43	44	60
Numbers of Pools in Play						1.05/2.09		4	5	6	7	8	17

Zero Pools at F24.63

Minimum Number of Pools	2 (F20)	Mean Number of Pools	1.05	Maximum Number of Pools	17
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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)	20	49	62	92	142	167/104	213	265	300	377	420	470	833
Gas Recovery Factor (Mcfg/acre-foot)	180	326	387	525	735	797/365	997	1177	1294	1477	1650	1750	2985
Gas Oil Ratio (Sol'n Gas)(cf/bbl)	200	570	630	730	820	822/174	930	990	1030	1090	1150	1190	1450
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)= 9.273 σ^2 (sigma squared)= 1.350 Random Number Generator Seed= 113487

BOE Conversion Factor (cf/bbl)	5620	Probability Any Pool Contains Both Oil and Free Gas (Gas Cap)	0.23
Probability Any Pool is 100% Oil	0.34	Fraction of Pool Volume Gas-Bearing in Oil Pools with Gas Cap	0.5
Probability Any Pool is 100% Gas	0.43		

Table 3. Input data for Chukchi Sea play 19, 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: AAAAADAT			Play No.		19
World	Level	-	World	Level	Resources
Country	Level	-	UNITED	STATES	OF AMERICA
Region	Level	-	MMS	-	ALASKA REGION
Basin	Level	-	CHUKCHI	SEA	SHELF
Play	Level	-	Play		19 Sag Sequence (Upper Brookian)
Geologist	Kirk	W.	Sherwood		- North Chukchi Basin
Remarks	2005 Assessment				
Run Date & Time:	Date	19-Sep-05	Time	13:55:56	

Summary of Play Potential

Product	MEAN	Standard Deviation
BOE (Mboe)	21,884	55,657
Oil (Mbo)	8,891	28,970
Condensate (Mbc)	2,732	7,977
Free (Gas Cap & Nonassociated) Gas (Mmcfg)	50,323	141,130
Solution Gas (Mmcfg)	7,346	24,934

10000 (Number of Trials in Sample)
 0.2461 (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	0	0	0	0	0
30	0	0	0	0	0
25	129	30	21	423	17
20	27,534	10,749	3,527	65,470	9,041
15	51,340	18,539	6,808	131,500	14,586
10	81,585	32,611	10,032	192,370	26,480
8	98,962	34,221	13,640	258,120	29,071
6	119,060	45,250	15,894	287,780	37,715
5	133,390	49,640	16,907	334,160	41,485
4	150,900	60,035	19,573	351,790	48,884
2	204,550	78,986	28,287	482,240	64,468
1	260,460	118,050	30,978	530,040	96,200
0.1	449,420	151,790	39,308	1,346,300	105,440
0.01	794,900	644,160	3,837	103,450	722,130
0.001	808,020	669,260	1,260	29,545	743,220

Table 5. Assessment results by commodity for Chukchi Sea play 19, 2006 assessment.

Basin: CHUKCHI SEA SHELF Play 19 - U. Brookian - Sag Phase-North Chukchi Basin UAI Key: AAAAADAT						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	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	0.009527	0.0001	0.000406	0	0	1	0	0	0	0	1	1	1	1	1	1	0.236257	236.256540		
4	0.25	0.5	27	0.257241	0.0027	0.010967	2	12	13	1	1	1	1	1	1	1	1	1	1	0.255447	394.047230		
5	0.5	1	164	1.5625	0.0164	0.066613	24	73	67	1	1	1	1	1	2	1	2	1	2	0.503956	794.094205		
6	1	2	606	5.773628	0.0606	0.246141	93	231	282	1	1	1	2	1	2	1	2	1	3	1.001903	1.535983		
7	2	4	1372	13.071647	0.1372	0.557271	318	458	596	1	2	1	3	1	3	1	3	1	4	2.000294	3.021660		
8	4	8	2251	21.446266	0.2251	0.914297	526	722	1003	1	3	1	4	1	3	1	3	1	6	4.000268	5.859517		
9	8	16	2268	21.608232	0.2268	0.921202	545	773	950	1	3	1	4	1	3	1	3	1	5	8.003331	11.532894		
10	16	32	1923	18.321266	0.1923	0.781072	437	614	872	1	3	1	3	1	3	1	3	1	5	16.000912	22.582340		
11	32	64	1224	11.661586	0.1224	0.497157	279	405	540	1	2	1	3	1	2	1	2	1	4	32.014579	44.305756		
12	64	128	495	4.716082	0.0495	0.201056	107	167	221	1	2	1	3	1	2	1	2	1	4	64.014449	86.590118		
13	128	256	135	1.286204	0.0135	0.054833	32	53	50	1	1	1	1	1	1	1	1	1	2	128.116453	168.696320		
14	256	512	26	0.247713	0.0026	0.010561	4	13	9	1	1	1	1	1	1	1	1	1	1	258.910596	321.484222		
15	512	1024	4	0.038111	0.0004	0.001625	1	3	0	1	1	1	1	0	0	1	1	1	1	538.578425	657.336975		
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			Below Class								Below Class			0.000000		
Totals			10496	99.999992	1.0496	4.263201	Above Class			Above Class								Above Class			0.000000		
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.																	
Number of Pools below Class 1: 0																							
Number of Trials with Pools: 2462																							

Table 6. Statistics for simulation pools created in computer sampling run for Chukchi Sea play 19, 2006 assessment.

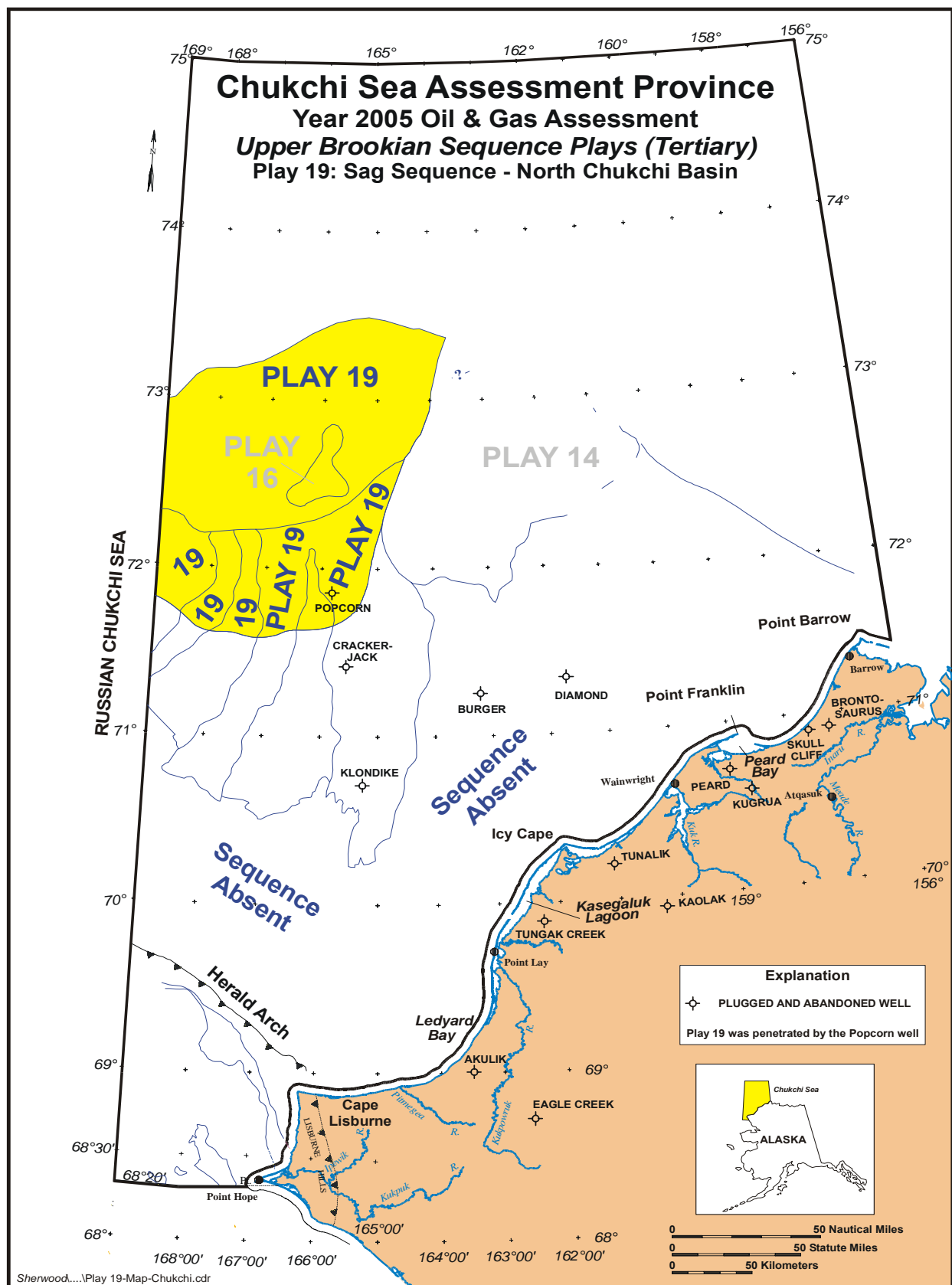


Figure 1. Map location of Chukchi Sea play 19, 2006 assessment.