

Chukchi Sea Play 5: Sadlerochit Gp.-Chukchi Platform

Geological Assessment

GRASP UAI: AAAAA DAF

Play Area: 4,860 square miles

Play Water Depth Range: 115-170 feet

Play Depth Range: 9,000-17,000 feet

Play Exploration Chance: 0.175

Play 5, Sadlerochit Gp.-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)	357	1,378	2,880
Total Gas (Tcfg)	1.076	4.344	9.179
Total Liquids (Mmbo)	165	605	1,247
Free Gas** (Tcfg)	0.702	3.065	6.597
Solution Gas (Tcfg)	0.374	1.279	2.582
Oil (Mmbo)	129	439	892
Condensate (Mmbc)	36	166	355

* 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 5, the “Sadlerochit Group-Chukchi Platform” play, is the 8th-ranking play (of 29 plays) in the Chukchi Sea OCS Planning Area, with 4.7% (1,378 Mmboe) of the Planning Area energy endowment (29,041 Mmboe). The overall assessment results for play 5 are shown in [table 1](#). Oil and gas-condensate liquids form 44% of the hydrocarbon energy endowment of play 5.

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

[Table 3](#) summarizes the volumetric input data developed for the GRASP computer model of Chukchi Sea play 5. [Table 4](#) reports the risk model used for play 5. The location of play 5 is shown in [figure 1](#).

The reservoir objectives of play 5 lie within Late Permian to Jurassic marine strata deposited on the western side of Hanna trough, mostly during a "sag" or thermal phase of subsidence that followed the fault-driven subsidence that controlled Lower Ellesmerian sedimentation in Hanna trough.

The only potential reservoirs encountered in wells are spiculitic mudstones and cherts offering sparse moldic porosity (Crackerjack well), and some marine sandstones (Klondike well, Kavik(?) sandstone, 11,100-11,625 ft). More proximal (nearshore, littoral) sandstones postulated to have been deposited to the west have been lost to truncation at Mesozoic unconformities. The probable absence of a western, proximal, reservoir-quality sandstone facies forms a major risk element for this play. Hydrocarbons are primarily derived from Triassic source beds of the Hanna trough play charging system, with migration paths to the west beneath regional seals into large stratigraphic traps. Early-formed stratigraphic traps were disrupted by Paleocene transtensional faults in some areas and trap integrity may be an additional risk element for this play. Play 5 was penetrated by Crackerjack and Klondike wells, both of which encountered pooled hydrocarbons within the play sequence.

A maximum of 23 hypothetical pools is forecast by the aggregation of the risk model and the prospect numbers model for play 5. These 23 pools range in mean conditional (un-risked) recoverable volumes from 11 Mmboe (pool rank 23) to 587 Mmboe (pool rank 1). Pool rank 1 ranges in possible conditional recoverable volumes from 148 Mmboe (F95) to 1,486 Mmboe (F05). Table 2 shows the conditional sizes of the 10 largest pools in play 5.

size class 12 ranges from 64 to 128 Mmboe. The largest simulation pool for play 5 falls 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 5.

Play 5, Sadlerochit Gp.-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	148	587	1486
2	76	294	624
3	42	191	417
4	26	134	302
5	17	99	228
6	12	75	179
7	10	60	145
8	8	49	120
9	7	41	101
10	6	36	88

* 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 5 a total of 73,945 “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 (16,582, or 22%) of simulation pools (conditional, technically recoverable BOE resources) for play 5. Pool

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

Basin: Chukchi Sea Planning Area
Play Number: 05
Play UAI Number: AAAAA DAF

Assessor: K.W. Sherwood
Play Name: Sadlerochit Gp.- Chukchi Platform

Date: January 2005

Play Area: mi² (million acres) 4,860 (3,110)
Reservoir Thermal Maturity: % Ro 1.45-1.83

Play Depth Range: feet 9,000 - 17,000 (mean = 12,545)
Expected Oil Gravity: ° API 30
Play Water Depth Range: feet 115 - 170 (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*	1120		3801		15936	29786/47034			66814				81455
Prospect Area (acres)-Model Output**	1133	2573	3852	7237	14494	20333/17558	27882	38363	47013	58925			81411
Fill Fraction (Fraction of Area Filled)	0.18	0.30	0.32	0.37	0.43	0.44/0.10	0.50	0.54	0.58	0.62			1.00
Productive Area of Pool (acres)***	308	1082	1642	3021	6248	8992/8349	12128	16953	20874	27355	31000	33000	55104
Pay Thickness (feet)	10	62	69	82	100	104/30	121	135	144	160	180	195	350

* 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*	1
Output Play Level Chance**	0.9993

Prospect Level Chance	0.175
-----------------------	-------

Exploration Chance	0.175
--------------------	-------

* (Oil Swabbed from Shublik Fm. At Klondike Well)

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

Risk Model	Play Chance	Petroleum System Factors	Prospect Chance
		Reservoir (presence)	0.45
		Chance Porosity >10%	0.35

Fractile	F99	F95	F90	F75	F50	Mean/Std. Dev.	F25	F15	F10	F05	F02	F01	F00
Numbers of Prospects in Play	32	33	36	39	41	42.27/4.95	45	46	49	50	52	54	64
Numbers of Pools in Play	2	3	4	6	7	7.40/2.62	9	10	11	12	13	14	23

Zero Pools at F99.96

Minimum Number of Pools	2 (F99)	Mean Number of Pools	7.4	Maximum Number of Pools	23
-------------------------	---------	----------------------	-----	-------------------------	----

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)	15	36	43	57	81	100/66	120	153	179	225	290	320	722
Gas Recovery Factor (Mcfg/acre-foot)	321	611	677	812	1031	1134/455	1341	1554	1735	2039	2500	2700	4604
Gas Oil Ratio (Sol'n Gas)(cf/bbl)	1650	2400	2525	2700	2925	2917/362	3150	3250	3350	3475	3600	3700	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)= 11.536 σ^2 (sigma squared)= 1.348

Random Number Generator Seed= 340490

BOE Conversion Factor (cf/bbl)	5620
Probability Any Pool is 100% Oil	0.2
Probability Any Pool is 100% Gas	0.2

Probability Any Pool Contains Both Oil and Free Gas (Gas Cap)	0.6
Fraction of Pool Volume Gas-Bearing in Oil Pools with Gas Cap	0.3

Table 3. Input data for Chukchi Sea play 5, 2006 assessment.

Risk Analysis Form - 2006 National Assessment				
Assessment Province:	Chukchi Sea OCS Planning Area	Play Number, Name:	5. Sadlerochit Gp. - Chukchi Platform	
Assessor(s):	K.W. Sherwood	Play UAI:	AAAAA DAF	
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	1.0000	1.0000
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	1.00	1.00
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	0.1750
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	0.50
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	0.35
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)			1.0000	
(1 * 2 * 3) Product of All Subjective Play Chance Factors				
Average Conditional Prospect Chance¹				0.1750
(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			0.1750	
(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				
Oil swabbed from Shublik Fm. at Klondike 1 well.				

Table 4. Risk model for Chukchi Sea play 5, 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: AAAAADAF **Play No. 5**

World Level - World Level Resources
 Country Level - UNITED STATES OF AMERICA
 Region Level - MMS ALASKA REGION
 Basin Level - **CHUKCHI SEA SHELF**
Play Level - Play 5 Sadlerochit Gp. - Chukchi Platform
 Geologist Kirk W. Sherwood
 Remarks 2005 Assessment
 Run Date & Time: Date 19-Sep-05 Time 13:52:37

Summary of Play Potential

Product	MEAN	Standard Deviation
BOE (Mboe)	1,377,900	802,080
Oil (Mbo)	439,090	313,770
Condensate (Mbc)	165,780	133,880
Free (Gas Cap & Nonassociated) Gas (Mmcf)	3,064,900	2,307,300
Solution Gas (Mmcf)	1,279,400	919,640

10000 (Number of Trials in Sample)
 0.9993 (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	149,990	53,800	15,918	297,220	153,920
95	356,660	129,040	36,143	702,100	374,040
90	499,630	166,260	57,375	1,065,300	485,780
85	611,320	204,700	69,915	1,298,800	593,430
80	713,190	246,440	76,562	1,471,700	721,220
75	800,790	264,850	96,789	1,707,700	760,290
70	887,020	308,430	97,577	1,805,500	897,780
65	972,620	331,900	107,930	2,022,700	971,540
60	1,053,700	358,830	123,680	2,184,500	1,025,500
55	1,138,900	399,240	116,850	2,339,800	1,160,300
50	1,232,500	411,790	138,960	2,635,000	1,196,200
45	1,330,600	415,280	162,140	3,030,900	1,202,100
40	1,425,900	467,450	161,090	3,112,600	1,368,800
35	1,539,500	478,220	183,700	3,541,200	1,390,800
30	1,662,400	541,190	197,010	3,620,100	1,573,800
25	1,798,900	548,050	231,720	4,141,600	1,585,900
20	1,963,500	652,160	208,650	4,279,500	1,917,600
15	2,155,600	661,200	275,560	4,921,300	1,928,400
10	2,433,300	793,680	287,950	5,283,000	2,313,600
8	2,591,800	767,390	332,900	6,128,600	2,253,500
6	2,775,500	895,890	332,140	6,082,800	2,614,000
5	2,880,100	892,010	354,840	6,597,100	2,581,500
4	3,008,500	874,230	406,740	7,171,300	2,537,400
2	3,455,100	1,029,500	449,300	8,130,400	2,976,100
1	3,895,700	1,172,900	493,190	9,103,000	3,427,400
0.1	5,319,700	2,087,800	427,410	9,289,200	6,471,700
0.01	6,908,000	3,185,700	590,250	8,201,500	9,400,100
0.001	8,905,700	5,546,300	89,328	1,374,300	17,003,000

Table 5. Assessment results by commodity for Chukchi Sea play 5, 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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000
4	0.25	0.5	1	0.001352	0.0001	0.0001	1	0	0	1	1	0	0	0	0	1	1	0	0	0.426388	0.426388
5	0.5	1	8	0.010819	0.0008	0.0008	2	6	0	1	1	1	1	0	0	1	1	0	0	0.527592	0.962164
6	1	2	40	0.054094	0.004	0.004002	22	16	2	1	1	1	1	1	1	1	1	1	1	1.045631	1.883550
7	2	4	260	0.351613	0.026	0.026016	150	94	16	1	1	1	2	1	1	1	1	1	2	2.012142	3.988376
8	4	8	1179	1.594428	0.1179	0.117971	628	412	139	1	2	1	2	1	2	1	2	1	3	4.020444	7.999006
9	8	16	3301	4.464129	0.3301	0.330298	1864	1048	389	1	3	1	3	1	2	1	4	1	4	8.001112	15.998453
10	16	32	7121	9.630131	0.7121	0.712528	4230	1968	923	1	4	1	4	1	2	1	5	1	5	16.000774	31.989187
11	32	64	12469	16.862534	1.2469	1.247649	7586	2861	2022	1	6	1	4	1	3	1	8	1	8	32.003360	63.995518
12	64	128	16582	22.424776	1.6582	1.659196	10281	3265	3036	1	7	1	5	1	5	1	8	1	8	64.002001	127.992510
13	128	256	16505	22.320644	1.6505	1.651491	10229	2841	3435	1	6	1	4	1	4	1	8	1	8	128.002602	255.999811
14	256	512	10988	14.859693	1.0988	1.09946	6557	1570	2861	1	5	1	3	1	4	1	7	1	7	256.026562	511.999907
15	512	1024	4540	6.139699	0.454	0.454273	2436	530	1574	1	3	1	2	1	3	1	6	1	6	512.185803	1022.899000
16	1024	2048	857	1.15897	0.0857	0.085751	390	116	351	1	2	1	1	1	2	1	3	1	3	1024.452000	2045.754000
17	2048	4096	89	0.12036	0.0089	0.008905	30	17	42	1	1	1	1	1	1	1	1	1	1	2060.153000	3927.679000
18	4096	8192	4	0.005409	0.0004	0.0004	2	0	2	1	1	0	0	1	1	1	1	1	1	4134.643000	4745.031000
19	8192	16384	1	0.001352	0.0001	0.0001	0	1	0	0	0	1	1	0	0	0	1	1	1	8927.986000	8927.986000
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	0	0	0	0	0	0	0	0	0	Below Class	0.000000
Totals			73945	100.000008	7.3945	7.398939	Above Class	0	0	0	0	0	0	0	0	0	0	0	0	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.	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: 9994		

Table 6. Statistics for simulation pools created in computer sampling run for Chukchi Sea play 5, 2006 assessment.

