

Chukchi Sea Play 9: Rift Sequence-Deep Gas

Geological Assessment

GRASP UAI: AAAAA DAJ

Play Area: 7,666 square miles

Play Water Depth Range: 100-150 feet

Play Depth Range: 9,000-22,775 feet

Play Exploration Chance: 0.042

Play 9, Rift Sequence-Deep Gas, 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	48	237
Total Gas (Tcfg)	0.000	0.237	1.168
Total Liquids (Mmbo)	0	6	29
Free Gas** (Tcfg)	0.000	0.237	1.168
Solution Gas (Tcfg)	0.000	0.000	0.000
Oil (Mmbo)	0	0	0
Condensate (Mmbc)	0	6	29

* 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 9, the “Rift Sequence-Deep Gas” play, is the 26th-ranking play (of 29 plays) in the Chukchi Sea OCS Planning Area, with 0.2% (48 Mmboe) of the Planning Area energy endowment (29,041 Mmboe). Play 9 is assessed as offering non-associated gas in all pools. The overall assessment results for play 9 are shown in [table 1](#). Gas-condensate liquids form 12% of the hydrocarbon energy

endowment of play 9. [Table 5](#) reports the detailed assessment results by commodity for play 9.

[Table 3](#) summarizes the volumetric input data developed for the *GRASP* computer model of Chukchi Sea play 9. [Table 4](#) reports the risk model used for play 9. The location of play 9 is shown in [figure 1](#).

Play 9 includes prospects that lie at subsurface depths beneath the petroleum liquids survival “floor” (2.0% vitrinite reflectance) and that would therefore contain only gas. Reservoir objectives would be primarily thin, basin-floor turbidite sandstones deposited in the basin plain area south of the stable shelf sedimentary province of the Rift sequence. However, in western Arctic Alaska, shelf deposits in the play sequence (e.g., at Tunalik well) enter the all-gas window as well. The anticipated hydrocarbon mix is 100 percent non-associated gas, probably derived from underlying, oil-expended Shublik source beds of the Hanna trough play charging system, or marine shales (upper Kingak Formation, Kuparuk Formation, Pebble Shale) within the Rift sequence. High levels of thermal maturity for prospect reservoirs are expected to have an adverse effect on reservoir properties, which primarily accounts for the small endowment of this play. All of the “unidentified” prospects used to construct the prospect numbers distribution for this play were estimated using a prospect density (area basis) that was devised from mapping “geobodies” imaged by seismic attributes in three-dimensional seismic data within the correlative sequence in the National Petroleum Reserve-Alaska (NPR). The

size range of these “geobodies” also helped define the prospect area distribution. Play 9 was penetrated at Tunalik well, which encountered pooled gas (logs) in a Kuparuk-equivalent sandstone at 12,508 feet within the play sequence.

of 19,647 “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 (3,724, or 19%) of simulation pools (conditional, technically recoverable BOE resources) for play 9. Pool size class 9 ranges from 8 to 16 Mmboe (or 0.04 to 0.09 Tcfge). The largest 2 simulation pools for play 9 fall within pool size class 15, which ranges in size from 512 to 1,024 Mmboe (or 2.9-5.8 Tcfge). [Table 6](#) reports statistics for the simulation pools developed in the GRASP computer model for play 9.

Play 9, Rift Sequence-Deep Gas, 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	64	165
2	3	29	81
3	2	18	50
4	1.3	12	36
5	1.0	9	27
6	0.9	8	22
7	0.82	6	19
8	0.76	5.6	17
9	0.72	5.1	15
10	0.69	4.7	14

* 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 36 hypothetical pools is forecast by the aggregation of the risk model and the prospect numbers model for play 9. These 36 pools range in mean conditional (un-risked) recoverable volumes from 1 Mmboe or 0.006 Tcfge (pool rank 36) to 64 Mmboe or 0.360 Tcfge (pool rank 1). Pool rank 1 ranges in possible conditional recoverable volumes from 7 Mmboe or 0.039 Tcfge (F95) to 165 Mmboe or 0.927 Tcfge (F05). [Table 2](#) shows the conditional sizes of the 10 largest pools in play 9.

In the computer simulation for play 9 a total

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

Basin: Chukchi Sea Planning Area
 Play Number: 09
 Play UAI Number: AAAAA DAJ

Assessor: K.W. Sherwood
 Play Name: Rift Sequence - Deep Gas

Date: January 2005

Play Area: mi² (million acres) 7,666 (4.906)
 Reservoir Thermal Maturity: % Ro 2.03-6.00

Play Depth Range: feet 9,000 - 22,775 (mean = 17,352)
 Expected Oil Gravity: ° API 60 (No Free Oil)
 Play Water Depth Range: feet 100 - 150 (mean = 130)

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*	318		744		4557	12379/31271			27895				52520
Prospect Area (acres)-Model Output**	318	606	880	1889	4525	8522/10151	11018	17004	22186	31955			52374
Fill Fraction (Fraction of Area Filled)	0.25	0.38	0.40	0.45	0.51	0.52/0.10	0.57	0.61	0.64	0.69			1.00
Productive Area of Pool (acres)***	116	295	441	953	2263	4398/5385	5519	8713	11255	16637	19000	21000	40022
Pay Thickness (feet)	9	12	13	16	20	21/7	25	28	30	33	38	41	70

* 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
Output Play Level Chance*	0.3906

Prospect Level Chance	0.105
-----------------------	-------

Exploration Chance	0.042
--------------------	-------

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

Risk Model	Play Chance	Petroleum System Factors	Prospect Chance
	0.4	Reservoir Presence (distal facies)	0.03
		Chance Porosity > 10%	0.105

Fractile	F99	F95	F90	F75	F50	Mean/Std. Dev.	F25	F15	F10	F05	F02	F01	F00
Numbers of Prospects in Play	16	21	24	32	41	46.64/22.17	55	65	72	84	100	115	212
Numbers of Pools in Play						1.96/3.11	4	5	6	8	11	12	36

Zero Pools at F39.09

Minimum Number of Pools	2 (F35)
-------------------------	---------

Mean Number of Pools	1.96
----------------------	------

Maximum Number of Pools	36
-------------------------	----

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)	No Free Oil												
Gas Recovery Factor (Mcfg/acre-foot)	439	728	804	957	1174	1266/449	1475	1672	1836	2113	2500	2700	4603
Gas Oil Ratio (Sol'n Gas)(cf/bbl)	No Free Oil												
Condensate Yield ((bbl)/Mmcf)	13	18	19	22	25	25/5	28	30	31	33	36	38	50
Pool Size Distribution Statistics from <i>POOLS</i> (1,000 BOE):	μ (mu)= 9.337						σ^2 (sigma squared)= 1.696			Random Number Generator Seed= 822952			

BOE Conversion Factor (cf/bbl)	5620
Probability Any Pool is 100% Oil	0
Probability Any Pool is 100% Gas	1

Probability Any Pool Contains Both Oil and Free Gas (Gas Cap)	0
Fraction of Pool Volume Gas-Bearing in Oil Pools with Gas Cap	1

Table 3. Input data for Chukchi Sea play 9, 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: AAAAAAJ	Play No. 9
World Level -	World Level Resources
Country Level -	UNITED STATES OF AMERICA
Region Level -	MMS - ALASKA REGION
Basin Level -	CHUKCHI SEA SHELF
Play Level -	9 Rift Sequence - Deep Gas
Geologist Kirk W.	Sherwood
Remarks 2005 Assessment	
Run Date & Time: Date	19-Sep-05 Time 13:53:29

Summary of Play Potential

Product	MEAN	Standard Deviation
BOE (Mboe)	48,107	90,792
Oil (Mbo)	0	0
Condensate (Mbc)	5,946	11,332
Free (Gas Cap & Nonassociated) Gas (Mmcfg)	236,950	447,040
Solution Gas (Mmcfg)	0	0

10000 (Number of Trials in Sample)
 0.3906 (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	20,206	0	2,532	99,327	0
30	42,234	0	5,301	207,570	0
25	65,593	0	8,144	322,870	0
20	94,135	0	11,594	463,880	0
15	123,660	0	15,109	610,030	0
10	165,460	0	20,649	813,860	0
8	188,160	0	23,592	924,850	0
6	218,630	0	27,643	1,073,400	0
5	236,530	0	28,666	1,168,200	0
4	259,000	0	32,738	1,271,600	0
2	327,530	0	40,709	1,611,900	0
1	402,180	0	49,568	1,981,700	0
0.1	696,860	0	112,050	3,286,600	0
0.01	962,250	0	119,720	4,735,000	0
0.001	1,085,800	0	143,600	5,295,200	0

Table 5. Assessment results by commodity for Chukchi Sea play 9, 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	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	
2	0.0625	0.125	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	
3	0.125	0.25	5	0.025449	0.0005	0.00128	0	0	5	0	0	0	0	1	1	1	1	0.139768	0.219971	
4	0.25	0.5	123	0.62605	0.0123	0.031482	0	0	123	0	0	0	0	1	2	1	2	0.251988	0.499976	
5	0.5	1	563	2.865577	0.0563	0.1441	0	0	563	0	0	0	0	1	3	1	3	0.502663	0.999272	
6	1	2	1302	6.626966	0.1302	0.333248	0	0	1302	0	0	0	0	1	5	1	5	1.000310	1.999000	
7	2	4	2447	12.454827	0.2447	0.626312	0	0	2447	0	0	0	0	1	7	1	7	2.000383	3.999442	
8	4	8	3287	16.730289	0.3287	0.84131	0	0	3287	0	0	0	0	1	10	1	10	4.000235	7.999037	
9	8	16	3724	18.954548	0.3724	0.953161	0	0	3724	0	0	0	0	1	11	1	11	8.001130	15.999079	
10	16	32	3628	18.465923	0.3628	0.92859	0	0	3628	0	0	0	0	1	9	1	9	16.001939	31.961684	
11	32	64	2727	13.879982	0.2727	0.697978	0	0	2727	0	0	0	0	1	8	1	8	32.007717	63.968386	
12	64	128	1410	7.176668	0.141	0.360891	0	0	1410	0	0	0	0	1	6	1	6	64.027901	127.958823	
13	128	256	378	1.923958	0.0378	0.096749	0	0	378	0	0	0	0	1	3	1	3	128.312627	248.561309	
14	256	512	51	0.259582	0.0051	0.013053	0	0	51	0	0	0	0	1	1	1	1	257.070903	511.713537	
15	512	1024	2	0.01018	0.0002	0.000512	0	0	2	0	0	0	0	1	1	1	1	574.949560	621.477910	
16	1024	2048	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	0.000000	0.000000	
18	4096	8192	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	
19	8192	16384	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	0.000000	0.000000	
21	32768	65536	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	
22	65536	131072	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	0.000000	0.000000	
24	262144	524288	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	
25	524288	1048576	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	0.000000
Totals			19647	100	1.9647	5.028666	Above Class	0	0	0								Above Class	0.000000	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: 3907		

Table 6. Statistics for simulation pools created in computer sampling run for Chukchi sea play 9, 2006 assessment.

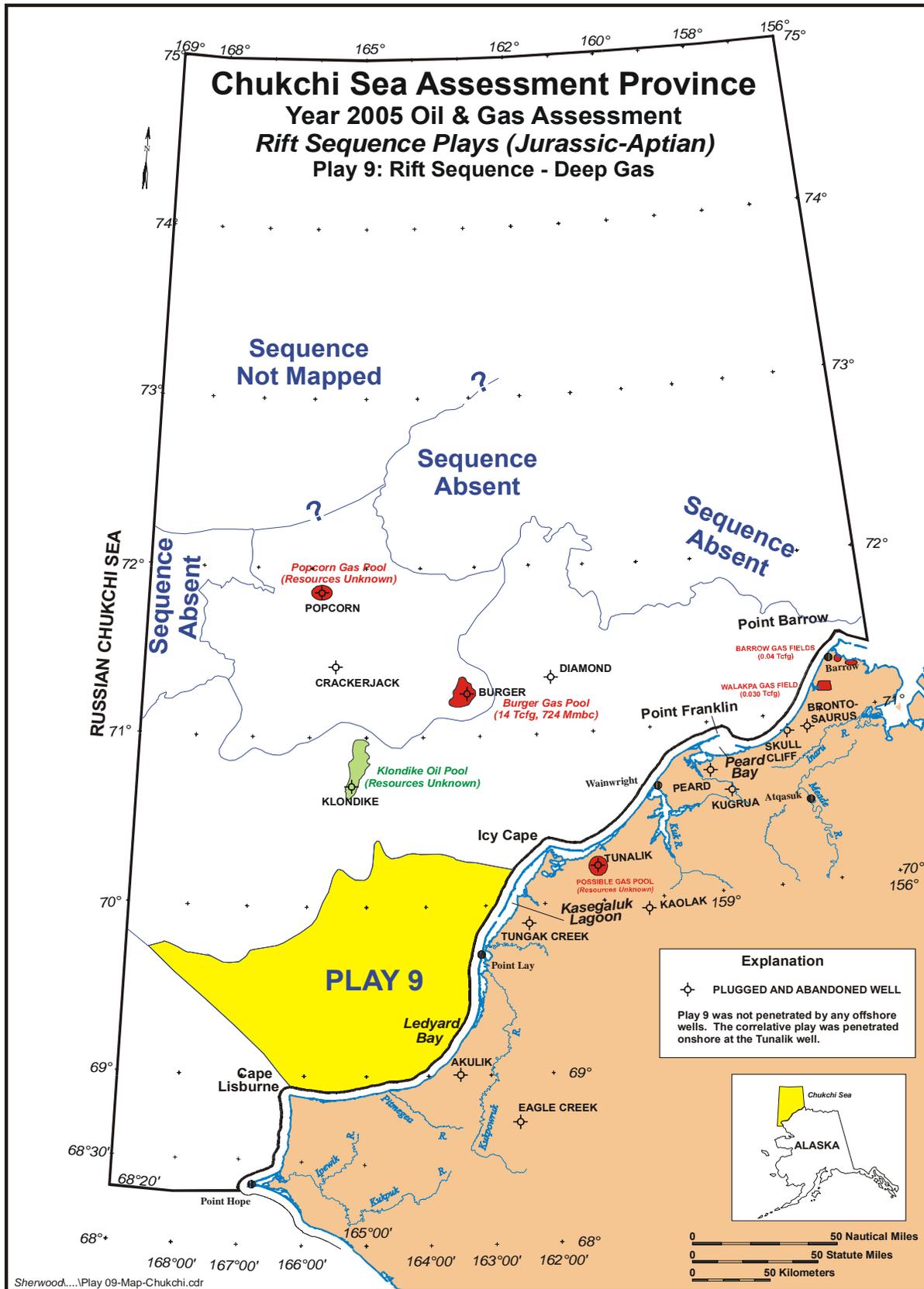


Figure 1. Map location of Chukchi Sea play 9, 2006 assessment.