

## **Chukchi Sea Play 13: Nanushuk Topset Sandstones (Lower Brookian)-Chukchi Wrench Zone**

### **Geological Assessment**

*GRASP UAI: AAAAA DAN*

*Play Area: 15,678 square miles*

*Play Water Depth Range: 100-170 feet*

*Play Depth Range: 1,600-16,500 feet*

*Play Exploration Chance: 0.0245*

<b>Play 13, Nanushuk Topset Sandstones (Lower Brookian)-Chukchi Wrench Zone, Chukchi Sea OCS Planning Area, 2006 Assessment, Undiscovered Technically-Recoverable Oil &amp; Gas</b>			
Assessment Results as of November 2005			
<b>Resource Commodity (Units)</b>	<b>Resources *</b>		
	<b>F95</b>	<b>Mean</b>	<b>F05</b>
BOE (Mmboe)	0	325	1,280
Total Gas (Tcfg)	0.000	0.908	3.562
Total Liquids (Mmbo)	0	163	647
Free Gas** (Tcfg)	0.000	0.595	2.319
Solution Gas (Tcfg)	0.000	0.313	1.243
Oil (Mmbo)	0	131	516
Condensate (Mmbc)	0	32	130
<p>* Risked, Technically-Recoverable</p> <p>** Free Gas Includes Gas Cap and Non-Associated Gas</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> <p>Mmb = millions of barrels</p> <p>Tcf = trillions of cubic feet</p>			

**Table 1**

Play 13, the “Nanushuk Topset-Chukchi Wrench Zone” play, is the 16<sup>th</sup>-ranked play (of 29 plays) in the Chukchi Sea OCS Planning Area, with 1.1% (325 Mmboe) of the Planning Area energy endowment (29,041 Mmboe). The overall assessment results for play 13 are shown in [table 1](#). Oil and gas-condensate liquids form 50% of the

hydrocarbon energy endowment of play 13.

[Table 5](#) reports the detailed assessment results by commodity for play 13.

[Table 3](#) summarizes the volumetric input data developed for the *GRASP* computer model of Chukchi Sea play 13. [Table 4](#) reports the risk model used for play 13. The location of play 13 is shown in [figure 1](#).

Potential reservoirs are primarily sandstones of the Albian-Cenomanian Nanushuk Group that were deposited in delta-plain and nearshore environments on the shelf terrace between Colville and North Chukchi basins, and, on Chukchi platform. The play was penetrated by two wells (Crackerjack and Klondike), which encountered only very sparse sandstones, some traces of oil, and no pooled hydrocarbons. Prospects are fault traps, faulted anticlines, and diapir-flank traps, as in (the underlying) play 12. This play, like play 12, is charged by the Hanna trough play charging system, with some hydrocarbons possibly re-migrated out of deeper Ellesmerian stratigraphic traps disrupted by faults.

A maximum of 22 hypothetical pools is forecast by the aggregation of the risk model and the prospect numbers model for play 13. These 22 pools range in mean conditional (un-risked) recoverable volumes from 5 Mmboe (pool rank 22) to 347 Mmboe (pool rank 1). Pool rank 1 ranges in possible conditional recoverable volumes from 55 Mmboe (F95) to 1,017 Mmboe (F05). [Table 2](#) shows the conditional sizes of the 10 largest pools in play 13.

Play 13, Nanushuk Topset Sandstones (Lower Brookian)-Chukchi Wrench Zone, 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	55	347	1017
2	24	144	370
3	12	85	213
4	8	56	142
5	5	41	104
6	4	31	80
7	3	25	64
8	2.9	20	53
9	2.6	17	45
10	2.3	15	39
<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 13 a total of 30,061 "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 (6,371, or 21%) of simulation pools (conditional, technically recoverable BOE resources) for play 13. Pool size class 11 ranges from 32 to 64 Mmboe. The largest 3 simulation pools for play 13 fall within pool size class 18, which ranges in size from 4,096 to 8,192 Mmboe. [Table 6](#) reports statistics for the simulation pools developed in the *GRASP* computer model for play 13.

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

**Basin:** Chukchi Sea Planning Area  
**Play Number:** 13  
**Play UAI Number:** AAAAA DAN

**Assessor:** K.W. Sherwood  
**Play Name:** Nanushuk Topset Sandstones (Lower Brookian) - Chukchi Wrench Zone

**Date:** January 2005

**Play Area:** mi<sup>2</sup> (million acres) 15,678 (10.034)  
**Reservoir Thermal Maturity:** % Ro 0.58 - 1.47

**Play Depth Range:** feet 1,600 - 16,500 (mean = 5,745)  
**Expected Oil Gravity:** ° API 30  
**Play Water Depth Range:** feet 100 - 170 (mean = 155)

### 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*	306		1812		7655	14404/22958			32340				123319
Prospect Area (acres)-Model Output**	315	1156	1808	3678	7635	13134/15927	15917	23626	30754	45459			122965
Fill Fraction (Fraction of Area Filled)	0.18	0.30	0.33	0.37	0.43	0.44/0.10	0.50	0.54	0.57	0.61			1.00
Productive Area of Pool (acres)***	119	499	761	1572	3327	5809/7303	6877	10505	13716	20450	30000	33000	69707
Pay Thickness (feet)	14	30	44	55	70	75/29	90	103	113	129	150	166	300

\* 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	0.49	Prospect Level Chance	0.05	Exploration Chance	0.0245
Output Play Level Chance*	0.4886				

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

Risk Model	Play Chance	Petroleum System Factors	Prospect Chance
	0.7	Trap Integrity (shallow reservoir, fault-bounded traps, no regional seal)	0.2
		Reservoir Presence (sandstones absent in wells offshore)	0.5
		Chance Porosity > 10%	0.5
	0.7	Migration (risk of diversion up young wrench faults)	0.5

Fractile	F99	F95	F90	F75	F50	Mean/Std. Dev.	F25	F15	F10	F05	F02	F01	F00
Numbers of Prospects in Play	93	99	105	115	120	122.75/14.35	130	135	140	150	155	160	186
Numbers of Pools in Play						3.01/3.54	6	7	8	9	11	12	22

Zero Pools at F48.89

Minimum Number of Pools	3 (F45)	Mean Number of Pools	3.01	Maximum Number of Pools	22
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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)	41	72	81	101	134	154/77	185	221	250	303	370	410	807
Gas Recovery Factor (Mcf/acre-foot)	223	553	635	791	1028	1126/485	1350	1565	1745	2036	2400	2600	4785
Gas Oil Ratio (Sol'n Gas)(cf/bbl)	270	1550	1750	2050	2400	2388/592	2750	2950	3100	3300	3500	3650	4500
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):  $\mu$  (mu)= 10.825  $\sigma^2$  (sigma squared)= 1.624 Random Number Generator Seed= 925439

BOE Conversion Factor (cf/bbl)	5620	Probability Any Pool Contains Both Oil and Free Gas (Gas Cap)	0.6
Probability Any Pool is 100% Oil	0.2	Fraction of Pool Volume Gas-Bearing in Oil Pools with Gas Cap	0.3
Probability Any Pool is 100% Gas	0.2		

Table 3. Input data for Chukchi Sea play 13, 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

<b>Play UAI: AAAAADAN</b>	<b>Play No. 13</b>	
World Level -	World Level -	Resources
Country Level -	UNITED STATES	OF AMERICA
Region Level -	MMS -	ALASKA REGION
Basin Level -	<b>CHUKCHI SEA</b>	<b>SHELF</b>
<b>Play Level -</b>	<b>Play</b>	<b>13 Nanushuk Topset Sandstones (Lower Brookian) - Chukchi Wrench Zone</b>
Geologist Kirk W.	Sherwood	
Remarks 2005 Assessment		
Run Date & Time: Date	19-Sep-05 Time	13:54:32

**Summary of Play Potential**

Product	MEAN	Standard Deviation
<b>BOE (Mboe)</b>	324,840	497,650
<b>Oil (Mbo)</b>	131,140	222,220
<b>Condensate (Mbc)</b>	32,168	63,385
<b>Free (Gas Cap &amp; Nonassociated) Gas (Mmcfg)</b>	595,320	1,073,400
<b>Solution Gas (Mmcfg)</b>	312,500	536,590

10000 (Number of Trials in Sample)

0.4886 (MPhc [Probability] of First Occurrence of Non-Zero Resource)

Windowing Feature: used

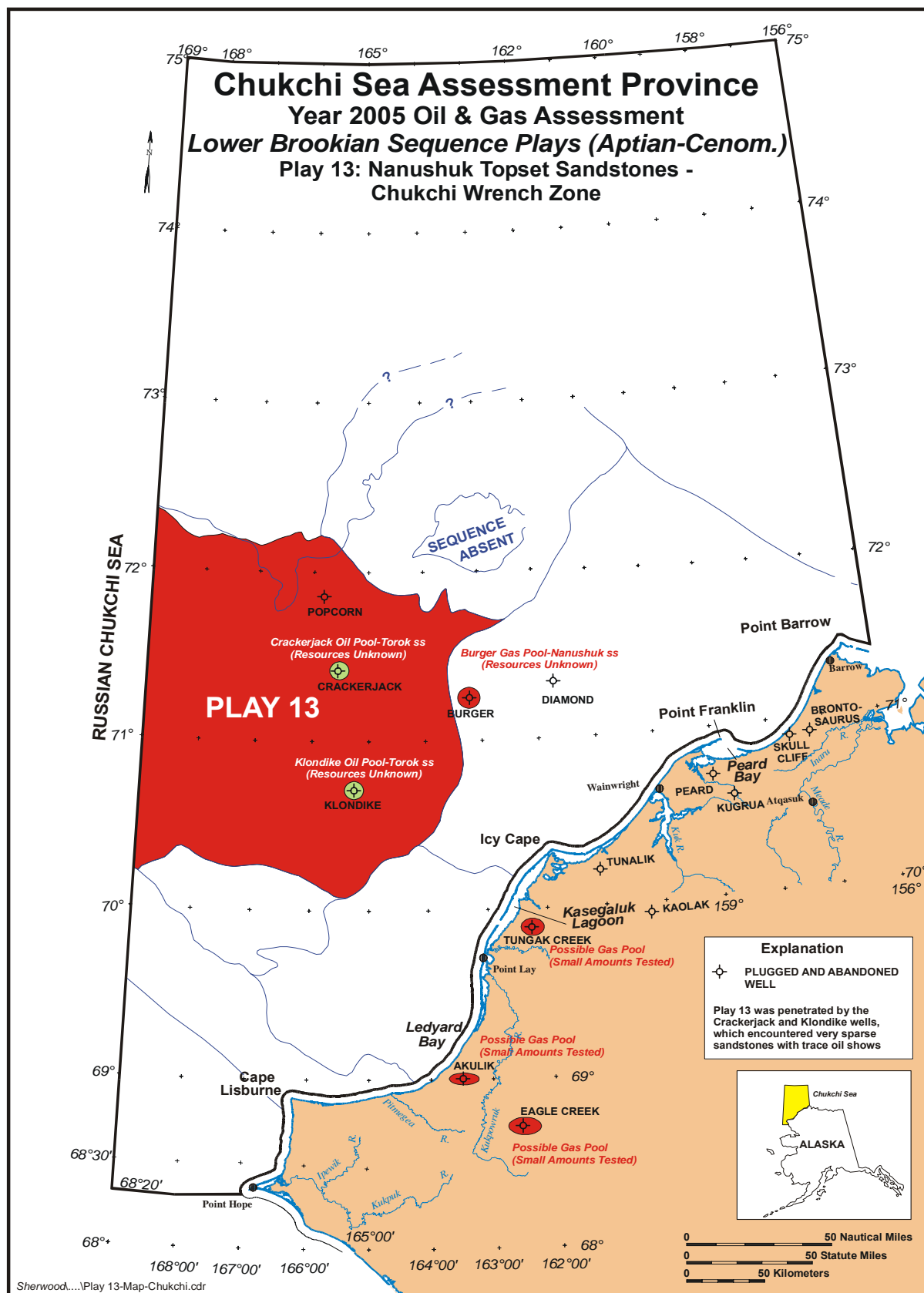
**Empirical Probability Distributions of the Products**

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	146,980	61,598	14,133	254,710	145,690
40	246,710	94,854	25,584	483,070	226,570
35	337,590	144,030	30,963	581,710	332,090
30	423,080	165,150	44,074	807,300	394,540
25	522,950	205,710	52,521	998,050	489,640
20	636,990	262,850	60,424	1,143,300	619,850
15	771,260	305,250	74,329	1,461,700	739,500
10	960,350	401,430	89,756	1,662,700	973,950
8	1,062,900	431,880	106,800	1,923,000	1,022,900
6	1,184,500	467,790	121,550	2,214,500	1,130,300
5	1,280,400	516,380	130,200	2,318,800	1,243,400
4	1,411,700	590,550	132,950	2,451,600	1,416,100
2	1,801,600	756,380	158,860	3,159,100	1,822,000
1	2,206,400	853,350	232,320	4,257,700	2,040,700
0.1	3,690,400	1,632,000	429,980	5,392,600	3,759,500
0.01	5,292,100	497,600	1,706,900	16,071,000	1,281,200
0.001	5,568,600	2,629,900	445,110	8,945,300	5,068,600

**Table 5.** Assessment results by commodity for Chukchi Sea play 13, 2006 assessment.

Basin: CHUKCHI SEA SHELF Play 13 - L. Brookian Wrench Zone - Nanushuk Topset UAI Key: AAAAADAN				Model Simulation "Pools" Reported by "Fieldsiz.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	8	0.026613	0.0008	0.001637	6	0	2	1	1	0	0	1	1	1	1	0.412191	0.498501	3.649817	456.227094		
5	0.5	1	54	0.179635	0.0054	0.01105	26	17	11	1	1	1	1	1	1	1	1	0.514299	0.993778	42.859213	793.689132		
6	1	2	178	0.592129	0.0178	0.036423	106	45	27	1	2	1	1	1	1	1	2	1.059817	1.998258	279.633699	1.570976		
7	2	4	668	2.222148	0.0668	0.136689	396	161	111	1	3	1	2	1	1	1	3	2.002362	3.994275	2052.725000	3.072942		
8	4	8	1533	5.099631	0.1533	0.313689	897	353	283	1	4	1	3	1	2	1	4	4.011215	7.998568	9275.175000	6.050342		
9	8	16	3160	10.511959	0.316	0.646613	1894	642	624	1	4	1	3	1	3	1	5	8.005424	15.995983	37543.942000	11.880994		
10	16	32	4972	16.539703	0.4972	1.017393	3044	1017	911	1	5	1	4	1	2	1	6	16.000799	31.996354	117847.324000	23.702198		
11	32	64	6371	21.193573	0.6371	1.303663	3860	1266	1245	1	5	1	3	1	3	1	6	32.002263	63.999759	295658.879000	46.406982		
12	64	128	6122	20.365257	0.6122	1.252711	3741	1153	1228	1	6	1	3	1	4	1	7	64.006659	127.974214	558269.477000	91.190704		
13	128	256	4085	13.589036	0.4085	0.835891	2383	757	945	1	5	1	3	1	4	1	6	128.018063	255.962545	733500.476000	179.559479		
14	256	512	1989	6.616546	0.1989	0.406998	1162	359	468	1	4	1	2	1	2	1	4	256.059339	511.743416	699894.107000	351.882416		
15	512	1024	741	2.464988	0.0741	0.151627	431	126	184	1	2	1	3	1	2	1	3	512.191041	1021.952000	513012.239000	692.324219		
16	1024	2048	155	0.515618	0.0155	0.031717	85	30	40	1	2	1	2	1	1	1	2	1027.714000	2037.335000	210165.685000	1.355908		
17	2048	4096	22	0.073185	0.0022	0.004502	11	5	6	1	1	1	1	1	1	1	1	2085.108000	4073.684000	57352.474000	2.606931		
18	4096	8192	3	0.00998	0.0003	0.000614	1	0	2	1	1	0	0	1	1	1	1	4489.697000	4498.826000	13487.349000	4.495783		
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			Below Class								Below Class					
Totals			30061	100	3.0061	6.151217	Above Class			Above Class								Above Class					
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: 4887																							

**Table 6.** Statistics for simulation pools created in computer sampling run for Chukchi Sea play 13, 2006 assessment.



**Figure 1.** Map location of Chukchi Sea play 13, 206 assessment.