

Hope Basin Play 3: Shallow (<10,000 ft) Basal Sandstones

Correlative to Chukchi Sea Play 28

Geological Assessment

GRASP UAI: AAAAA FAD

Play Area: 16,043 square miles

Play Water Depth Range: 30-180 feet

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

Play Exploration Chance: 0.04704

Play 3, Shallow (<10,000 ft) Basal Sandstones, Hope Basin 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	199	792
Total Gas (Tcfg)	0.000	0.922	3.658
Total Liquids (Mmbo)	0	34	142
Free Gas** (Tcfg)	0.000	0.911	3.612
Solution Gas (Tcfg)	0.000	0.010	0.046
Oil (Mmbo)	0	12	50
Condensate (Mmbc)	0	23	91
<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 3, the “Shallow Basal Sandstone” play, is a subordinate play in the Hope Basin OCS Planning Area, with 24% (199 Mmboe) of the Planning Area energy endowment (821 Mmboe). The overall assessment results for play 3 are shown in [table 1](#). Oil and gas-condensate liquids form 17% of the

hydrocarbon energy endowment of play 3.

[Table 5](#) reports the detailed assessment results by commodity for play 3.

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

Plays 3 and 4 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 (4) play. Potential source rocks for prospects in plays 3 and 4 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 3 lies partly within the zone of thermally mature strata and there would have access to thermogenic methane

¹extrapolated below well data using a Norton basin porosity decline rate

expelled from Tertiary rocks near the basin floor. Play 3 also extends across submature areas northward to the limit of Hope basin strata. In the submature area, play 3 would only have access to biogenic methane.

Play 3, Shallow (<10,000 ft) Basal Sandstones, Hope Basin 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	39	120	312
2	26	66	123
3	19	49	88
4	15	40	73
5	11	33	61
6	9	29	53
7	7	25	47
8	6	22	42
9	5	20	38
10	4	18	35
<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

A maximum of 93 hypothetical pools is forecast by the aggregation of the risk model and the prospect numbers model for play 3. These 93 pools range in mean conditional (un-risked) recoverable volumes from 1 Mmboe (pool rank 93) to 120 Mmboe (pool rank 1). Pool rank 1 ranges in possible conditional recoverable volumes from 39 Mmboe (F95) to 312 Mmboe (F05), or in a gas case from 0.22 Tcfge (F95) to 1.75 Tcfge (F05). [Table 2](#) shows the conditional sizes of the 10 largest pools in play 3.

In the computer simulation for play 3 a total of 72,981 "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 (19,640, or 27%) of simulation pools (conditional, technically recoverable BOE resources) for play 3. Pool size class 10 ranges from 16 to 32 Mmboe. The largest 14 simulation pools for play 3 fall within pool size class 15, which ranges in size from 512 to 1,024 Mmboe (or 3 to 6 Tcfge). [Table 6](#) reports statistics for the simulation pools developed in the *GRASP* computer model for play 3.

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

Basin: Hope Basin Planning Area
Play Number: 03
Play UAI Number: AAAAA FAD

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

Date: January 2005

Play Area: mi² (million acres) 16,043 (10,268)
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*	0.3997				

* 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	51	73	88	110	145	153.87/63.61	180	210	230	260	300	330	612
Numbers of Pools in Play						7.24/10.36	15	19	22	27	33	37	93

Zero Pools at F40.00

Minimum Number of Pools	10 (F35)	Mean Number of Pools	7.24	Maximum Number of Pools	93
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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 (Mcfg/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/Mmcfg)	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)= 0.983 Random Number Generator Seed= 263870

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 Hope basin play 3, 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: AAAAAFAD		Play No. 3	
World	Level -	World	Level Resources
Country	Level -	UNITED STATES	OF AMERICA
Region	Level -	MMS	ALASKA REGION
Basin	Level -	HOPE BASIN	
Play	Level -	Play	3 Shallow (<10,000 ft) Basal Sandstones
Geologist	Kirk W.	Sherwood	
Remarks	2005 Assessment		
Run Date & Time:	Date	19-Sep-05 Time	14:04:44

Summary of Play Potential

Product	MEAN	Standard Deviation
BOE (Mboe)	198,530	303,540
Oil (Mbo)	11,583	28,366
Condensate (Mbc)	22,894	35,121
Free (Gas Cap & Nonassociated) Gas (Mmcfg)	911,490	1,393,000
Solution Gas (Mmcfg)	10,475	25,702

10000 (Number of Trials in Sample)
 0.3997 (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	28,764	1,057	3,387	135,700	981
35	221,380	10,819	25,976	1,027,800	9,612
30	299,290	13,542	35,167	1,396,300	11,921
25	368,020	23,600	42,328	1,676,200	21,601
20	441,160	18,258	51,902	2,068,800	16,278
15	527,990	24,517	61,834	2,460,000	22,067
10	632,210	32,049	74,455	2,925,500	28,966
8	683,880	38,818	79,189	3,144,900	35,280
6	749,970	44,478	86,138	3,440,400	40,370
5	792,450	50,223	91,377	3,612,100	45,657
4	838,340	55,430	95,927	3,810,600	50,187
2	988,570	49,294	115,870	4,583,300	44,313
1	1,163,300	84,296	132,600	5,242,700	75,840
0.1	2,192,500	206,480	231,670	9,689,700	169,570
0.01	2,552,100	467,170	238,640	9,925,500	450,680
0.001	2,617,600	172,380	308,510	11,840,000	168,510

Table 5. Assessment results by commodity for Hope basin play 3, 2006 assessment.

Basin: HOPE BASIN Play 03 - Shallow Basal Sands UAI Key: AAAAAFAD				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	0.000000	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	3	0.004111	0.0003	0.00075	0	0	3	0	0	0	0	1	1	1	1	0.230351	0.245530	0.706233	235.410839		
4	0.25	0.5	41	0.056179	0.0041	0.010255	0	0	41	0	0	0	0	1	1	1	1	0.268372	0.497757	15.796008	385.268480		
5	0.5	1	261	0.357627	0.0261	0.065283	13	0	248	1	1	0	0	1	2	1	2	0.500026	0.996846	205.241348	786.365330		
6	1	2	1185	1.62371	0.1185	0.296398	62	0	1123	1	2	0	0	1	4	1	4	1.003247	1.998952	1843.102000	1.555360		
7	2	4	4091	5.605568	0.4091	1.023262	253	0	3838	1	3	0	0	1	10	1	10	2.000063	3.999915	12594.840000	3.078670		
8	4	8	10603	14.528439	1.0603	2.652076	795	0	9808	1	4	0	0	1	18	1	18	4.000205	7.998348	63947.967000	6.031120		
9	8	16	17716	24.274811	1.7716	4.431216	1764	0	15952	1	5	0	0	1	24	1	24	8.000293	15.999890	208140.376000	11.748723		
10	16	32	19640	26.911114	1.964	4.912456	2033	0	17607	1	8	0	0	1	28	1	29	16.001404	31.998284	449780.880000	22.901266		
11	32	64	13245	18.14856	1.3245	3.312907	1490	0	11755	1	4	0	0	1	18	1	20	32.000171	63.991349	586916.399000	44.312298		
12	64	128	4984	6.829175	0.4984	1.246623	670	0	4314	1	4	0	0	1	8	1	9	64.005211	127.883886	425038.466000	85.280594		
13	128	256	1034	1.416807	0.1034	0.258629	157	0	877	1	2	0	0	1	4	1	5	128.014802	254.957341	173640.462000	167.930817		
14	256	512	164	0.224716	0.0164	0.041021	15	0	149	1	1	0	0	1	2	1	2	256.183852	502.628876	54490.217000	332.257416		
15	512	1024	14	0.019183	0.0014	0.003502	3	0	11	1	1	0	0	1	1	1	1	541.875574	700.806718	8665.605000	618.971802		
16	1024	2048	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	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	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	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	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			72981	100	7.2981	18.254379	Above Class			Above Class								Above Class					
Number of Pools not Classified: 0																						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: 3998																							

Table 6. Statistics for simulation pools created in computer sampling run for Hope basin play 3, 2006 assessment.

HOPE BASIN

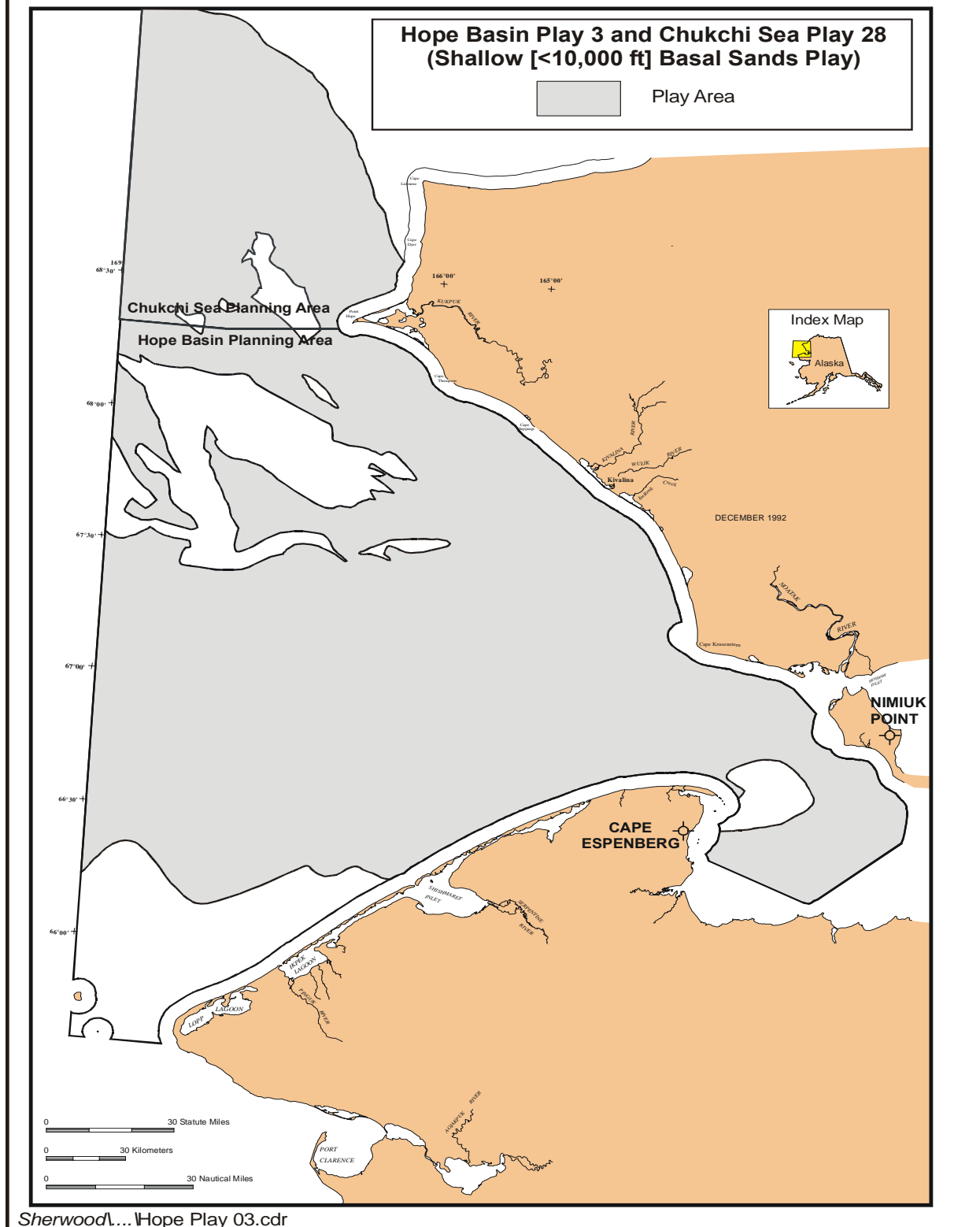


Figure 1. Map location of Hope basin play 3, 2006 assessment.