Cook Inlet Play 3: Mesozoic Structural Play

Geological Assessment
GRASP UAI: AAAAACAD
Play Area: 8,400 square miles
Play Water Depth Range: 100-600 feet
Play Depth Range: 4,000-10,000 feet
Play Exploration Chance: 0.18

Play 3, Mesozoic-Structural, Cook Inlet (Federal) 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)	61	354	833
Total Gas (Tcfg)	0.027	0.151	0.347
Total Liquids (Mmbo)	57	327	771
Free Gas** (Tcfg)	0.005	0.029	0.070
Solution Gas (Tcfg)	0.021	0.122	0.277
Oil (Mmbo)	56	325	767
Condensate (Mmbc)	0	2	4

* 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 3, the "Mesozoic Structural" play, is the third most important play (of four plays) in the Cook Inlet OCS Planning Area, with 29% (354 Mmboe) of the Planning Area energy endowment (1,225 Mmboe). The overall assessment results for play 3 are shown in table 1. Oil forms 92% 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 Cook Inlet play 3. Table 4 reports the risk model used for play 3. The location of play 3 is shown in figure 1.

The Mesozoic Structural play covers most of the assessment area, with the possible exception of the northernmost part, where the Mesozoic rocks are deeply buried. Structures tend to be northeast-trending anticlines cored by reverse faults. Those structures were formed during Plio-Pleistocene compression of the forearc basin. The Augustine-Seldovia arch is transverse to the regional structural trend and was drilled by three exploratory wells with no success. Transpressional folds formed by strike-slip movement associated with the Castle Mountain fault to the north of Cook Inlet may also be present.

Potential reservoir-rocks in play 3 are probably confined to Cretaceous strata. As in play 2, the thickest sandstones with the best porosities in the Mesozoic section are in non-marine, Upper Cretaceous fan-delta deposits. Those sandstones were encountered in the COST well, the Arco Y-0113 (Ibis) well, the Arco Y-0097 (Raven) well, and the Chevron Y-0243 (Falcon) well. Other potential reservoir sandstones may occur in turbidite fan complexes in the Upper Cretaceous Kaguyak Formation, similar to the type locality onshore on the Alaska Peninsula (Detterman and others, 1996). Although stratigraphically thinner, the Lower Cretaceous section may also contain reservoir-quality sandstones. The

quartz content tends to be higher than in the overlying Kaguyak Formation and the pore spaces are less occluded by zeolite minerals than the underlying Jurassic strata. Several of the OCS wells encountered sandstones of Albian age equivalent to the Pedmar Formation, which outcrops on the Alaska Peninsula. Also, the Lower Cretaceous Herendeen Formation may have reservoir-quality sandstones.

Source-rock potential for play 3 is the same as in plays 1 and 2: Upper Triassic carbonates of the Kamishak Formation or Middle Jurassic marine siltstones of the Tuxedni Group. The latter is the source for the upper Cook Inlet oil fields and the former is a source for oil seeps on the Alaska Peninsula near Paule Bay. Three of the OCS wells had oil shows, all north of the Augustine-Seldovia Arch. The Chevron Y-0243 (Falcon) well had minor oil shows, but was not tested. Oil was recovered in small quantities in drill-stem tests in the Marathon Y-0086 (Guppy) well and the Arco Y-0097 (Raven) well. Oil gravity was 30° and 28° API respectively in those tests. Thus, the viability of an oil source in play 3 has been confirmed.

All of the exploratory wells drilled in the OCS between 1978 and 1985 were on structural prospects in play 3. In all, nine prospects were tested in lower Cook Inlet and one in Shelikof Strait with no commercial success. Many undrilled structures remain, but this play is downgraded by the lack of adequate reservoir rock in wells to date.

A maximum of 21 hypothetical pools is forecast by the aggregation of the risk model and the prospect numbers model for play 3. These 21 pools range in mean conditional (un-risked) recoverable volumes from 6 Mmboe (pool rank 21) to 165 Mmboe (pool

rank 1). Pool rank 1 ranges in possible conditional recoverable volumes from 34 Mmboe (F95) to 435 Mmboe (F05). Table 2 shows the conditional sizes of the 10 largest pools in play 3.

Play 3, Mesozoic-Structural, Cook Inlet (Federal) 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	34	165	435
2	17	79	187
3	10	50	115
4	7	36	82
5	6	27	62
6	4.8	22	50
7	4.2	19	42
8	3.8	16	36
9	3.4	14	32
10	3.2	13	28
* 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 3 a total of 56,388 "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 (14,346, or 25%) of simulation pools (conditional, technically recoverable BOE resources) for play 3. Pool size class 11 ranges from 32 to 64 Mmboe. The largest simulation pool for play 3 falls within pool size class 16, which ranges in size from 1,024 to 2,048. 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: Lower Cook Inlet   **Assessor:** Comer / Larson   **Date:** March, 2005
Play Number: 3   **Play Name:** Mesozoic Structural Play
Play UAI Number: AAAAACAD

Play Area (mi², millions of acres): 8,400 (5.376)   **Play Depth Range, feet:** 4,000 - 6,000 - 10,000
Reservoir Thermal Maturity, % Ro: **Expected Oil Gravity, ° API:** 30
     Play Water Depth Range, feet: 100 - 400 - 600
     Prospect Distance from shore, miles: 35

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	0				5546	~~~				21400			~
Prospect Area (acres)-Model Output	134	1437	1937	3188	5546	7768.2 / 7618.9	9648	12987	15881	21400	29936	31400	32000
Fill Fraction (Fraction of Area Filled)	0.2	0.21	0.25	0.31	0.4	0.4303 / 0.17064	0.52	0.59	0.65	0.75	0.88	0.97	1
Productive Area of Pool (acres)	85	552	766	1324	2430	3609.94 / 3684.43	4461	6181	7708	10692	15453	19753	26487
Pay Thickness (feet)	13	34	41	54	75	84.360 / 43.750	104	123	139	165	201	229	443

MPRO Module (Numbers of Pools)

Play Level Chance	1	Prospect Level Chance	0.18	Exploration Chance	0.18

Risk Model	Play Chance	Petroleum System Factors	Prospect Chance
		[See Risking Sheet]	

Fractile	F100	F95	F90	F75	F50	Mean / Std. Dev.	F25	F15	F10	F05	F02	F01	F00
Numbers of Prospects in Play	18	21	23	26	30	31.34 / 6.63	35	38	40	43	47	49	50
Numbers of Pools in Play F99.6=0	F99 = 1	2	3	4	5	5.64 / 2.46	7	8	9	10	11	12	21

Minimum Number of Pools	0	Mean Number of Pools	5.64	Maximum Number of Pools	21

POOLS/PSRK/PSUM Module (Play Resources)

Fractile	F100	F95	F90	F75	F50	Mean / Std. Dev.	F25	F15	F10	F05	F02	F01	F00
Oil Recovery Factor (bbl/acre-foot)	106	148	156	172	191	193.339 / 30.836	212	225	233	247	263	275	343
Gas Recovery Factor (Mcfg/acre-foot)	287	416	444	495	559	568.094 / 104.258	631	673	704	751	808	849	1090
Gas Oil Ratio (Sol'n Gas)(cf/bbl)	143	193	220	274	350	374.603 / 142.092	447	510	558	637	739	815	1110
Condensate Yield ((bbl/Mmcfg)	20	40	42	47	52	52.692 / 8.796	58	62	64	68	73	76	100

Pool Size Distribution Statistics from *POOLS* (1,000 BOE): μ (mu) = 10.5079729 σ^2 (sigma squared) = 1.08129093   **Random Number Generator Seed** = 968049

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	0.9	Fraction of Pool Volume Gas-Bearing in Oil Pools with Gas Cap	0.3
Probability Any Pool is 100% Gas	0		

Table 3. Input data for Cook Inlet play 3, 2006 assessment.

Risk Analysis Form - 2005 National Assessment

Assessment Province:	Cook Inlet	**Play Number, Name:** 3, Mesozoic Structural
Assessor(s):	Comer	**Play UAI:** AAAACAD
Date:	6-Oct-05	

For each component, a *quantitative* probability of success (i.e., between zero and one, where zero indicates no confidence and one indicates absolute certainty) based on consideration of the *qualitative* 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	**Averge Conditional Prospect Chance[1]**
1. Hydrocarbon Fill component (1a * 1b * 1c)	**1**	*1.0000*	*0.7500*
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	0.75
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*	*0.3000*
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	0.60
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	0.50
3. Trap component (3a * 3b)	**3**	*1.0000*	*0.8000*
a. Presence of trap			
Probability of presence of the trap with a minimum rock volume (as specified in the resource assessment).	3a	1.00	0.80
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 Chance[1]		*0.1800*
(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		*0.1800*
(Product of Overall Play Chance and Average Conditional Prospect Chance)		

Comments: *See guidance document for explanation of the Risk Analysis Form*

Table 4. Risk model for Cook Inlet 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: AAAAACAD			**Play No.**		**3**	
World	Level	-	World	Level	Resources	
Country	Level	-	UNITED	STATES	OF	AMERICA
Region	Level	-	MMS	-	ALASKA	REGION
Basin	Level	-	**COOK**	**INLET**		
Play	**Level**	**-**	**Play**		**3 Mesozoic - Structural**	
Geologist	J.	Larson	/	D.	Comer	
Remarks	2005 Assessment					
Run Date & Time:		Date	19-Sep-05	Time	13:59:36	

Summary of Play Potential

Product	MEAN	Standard Deviation
BOE (Mboe)	353,820	249,400
Oil (Mbo)	325,390	230,280
Condensate (Mbc)	1,534	3,406
Free (Gas Cap & Nonassociated) Gas (Mmcfg)	29,232	63,742
Solution Gas (Mmcfg)	121,930	91,839

    10000 (Number of Trials in Sample)
    0.9958 (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	16,329	15,124	47	835	5,674
95	61,355	56,376	253	5,280	21,280
90	95,963	87,458	568	11,510	33,095
85	124,800	114,420	616	11,271	43,643
80	148,850	137,060	609	11,867	51,004
75	173,750	159,700	820	14,534	59,807
70	197,600	181,830	920	18,110	65,380
65	221,770	203,130	1,219	22,854	75,053
60	246,640	227,230	947	18,121	85,660
55	271,910	251,350	881	16,536	94,040
50	298,740	274,600	1,332	25,299	102,890
45	328,060	301,370	1,631	31,840	108,970
40	357,920	327,320	2,027	39,150	121,450
35	393,730	364,180	1,309	24,469	134,250
30	430,900	394,120	2,215	42,387	151,840
25	474,150	434,910	2,116	40,144	168,450
20	526,440	483,890	2,397	47,314	178,360
15	588,570	544,400	1,890	36,705	200,920
10	680,830	623,570	3,265	63,694	239,730
8	730,800	677,220	2,176	41,660	247,210
6	793,600	731,970	2,610	50,537	281,160
5	832,840	767,470	3,673	70,052	276,680
4	876,150	807,310	3,824	68,958	296,450
2	1,025,200	942,380	4,710	91,050	348,100
1	1,203,700	1,113,900	3,509	65,022	420,040
0.1	1,648,600	1,522,000	10,739	186,870	464,270
0.01	2,090,700	1,955,700	3,099	68,824	672,490
0.001	2,274,100	2,093,200	1,003	25,921	985,010

Table 5. Assessment results by commodity for Cook Inlet play 3, 2006 assessment.

Basin: COOK INLET
Play 03 - Mesozoic - Structural
UAI Key: AAAAACAD

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	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	2	0.003547	0.0002	0.000201	1	1	0	1	1	1	1	0	0	1	1	0.361897	0.464436	0.826334	413.166761
5	0.5	1	21	0.037242	0.0021	0.002109	1	20	0	1	1	1	1	0	0	1	1	0.503749	0.988225	17.628830	839.468122
6	1	2	143	0.2536	0.0143	0.014359	14	129	0	1	1	1	2	0	0	1	2	1.029270	1.996375	221.473485	1.548766
7	2	4	803	1.424062	0.0803	0.080631	115	688	0	1	2	1	3	0	0	1	3	2.010235	3.996829	2523.270000	3.142304
8	4	8	3148	5.582748	0.3148	0.316096	417	2731	0	1	3	1	5	0	0	1	5	4.000304	7.999881	19319.554000	6.137088
9	8	16	7974	14.141307	0.7974	0.800683	882	7092	0	1	2	1	8	0	0	1	8	8.000196	15.999820	96311.260000	12.078161
10	16	32	13205	23.418102	1.3205	1.325936	1328	11877	0	1	3	1	8	0	0	1	9	16.000657	31.999374	310769.845000	23.534256
11	32	64	14346	25.441584	1.4346	1.440506	1350	12996	0	1	3	1	8	0	0	1	8	32.004671	63.995272	657508.842000	45.832207
12	64	128	10205	18.097822	1.0205	1.024701	1027	9178	0	1	3	1	7	0	0	1	7	64.004978	127.999839	913097.517000	89.475502
13	128	256	4706	8.345747	0.4706	0.472537	422	4284	0	1	2	1	5	0	0	1	5	128.005441	255.836596	820515.615000	174.355209
14	256	512	1546	2.741718	0.1546	0.155236	97	1449	0	1	1	1	4	0	0	1	4	256.138035	510.152788	524187.561000	339.060516
15	512	1024	274	0.485919	0.0274	0.027513	19	255	0	1	1	1	2	0	0	1	2	512.272582	1019.525000	175749.950000	641.423157
16	1024	2048	15	0.026601	0.0015	0.001506	2	13	0	1	1	1	1	0	0	1	1	1055.765000	1532.759000	17969.864000	1.197991
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 0	0	0									Below Class 0.000000	0.000000	0.000000	0.000000
	Totals		56388	100	5.638801	5.662014	Above Class 0	0	0									Above Class 0.000000	0.000000	0.000000	0.000000

Number of Pools not Classified: 0
Number of Pools below Class 1: 0
Number of Trials with Pools: 9959

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.

Table 6. Statistics for simulation pools created in computer sampling run for Cook Inlet play 3, 2006 assessment.
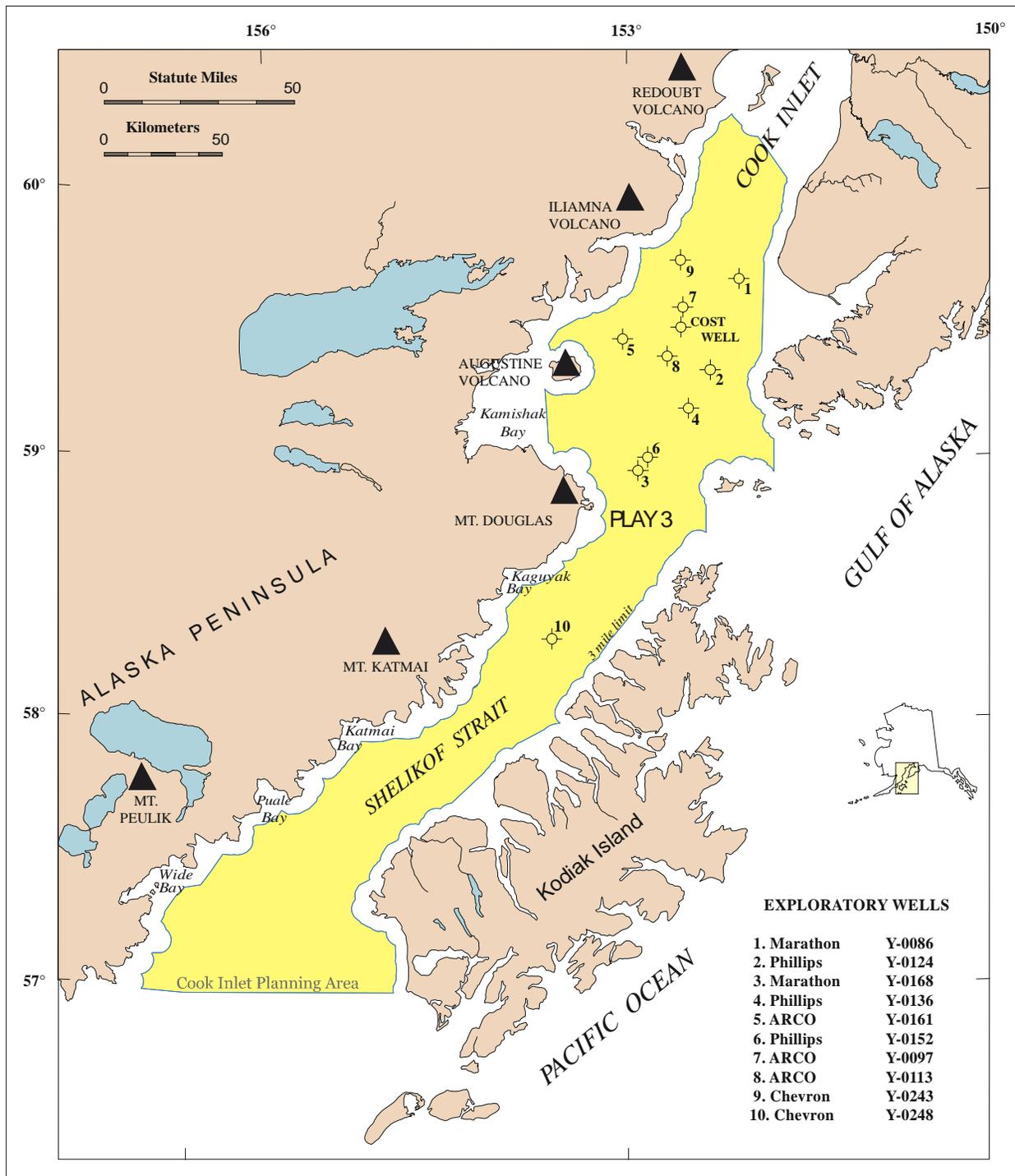
Figure 1. Map location of Cook Inlet play 3, 2006 assessment.