St. George Basin Planning Area (Alaska) – Province Summary

2006 Oil and Gas Assessment

Location

The St. George Basin Planning Area is located offshore western Alaska, as shown in figure 1. The St. George basin assessment province contains two main Cenozoic depocenters, the St. George graben and the Pribilof basin (fig. 2). The assessment area is on the outer Bering Sea shelf between the 100-meter isobath and the continental slope, at approximately the 200-meter isobath. The eastern boundary is the North Aleutian basin assessment province and the western boundary adjoins the Navarin basin assessment province.

Leasing and Exploration

Several grids of 2-D seismic data were collected throughout St. George basin from 1970 to 1985. Two Continental Offshore Stratigraphic Test (COST) wells were drilled in the basin in 1976 and 1982 (Turner and others, 1984a and 1984b). St. George Basin Lease Sale 70 was held in April of 1983 and bids were accepted on 96 tracts. The total of the winning bids was $426,458,830. Ten exploratory wells, including one sidetrack, were drilled from 1984 to 1985 with no discoveries reported. Subsequent scheduled lease sales were cancelled due to lack of interest during the industry downturn in the late 1980's. There are no currently active leases or lease sales scheduled in the planning area. The COST wells and exploratory wells are located in figure 2.

Geologic Setting

The outer Bering Sea shelf was a Mesozoic forearc margin prior to the formation of the Aleutian volcanic arc (Marlow and Cooper, 1980). Plate reorganization in the north Pacific region resulted in strike-slip tectonics in early Tertiary time. The St. George graben and the Pribilof basin opened as a result of transform motion along the outer Bering Sea shelf, overprinting the Mesozoic forearc margin with deep, rift-related depocenters (Worrall, 1991). The Aleutian volcanic arc probably formed in the early Eocene, at about 55 Ma (Scholl and others, 1983; 1986). Major faulting in the St. George basin continued through at least early Oligocene time, but the margin was ultimately isolated from further tectonic plate motion. The rift-related basins, and the surrounding stable platforms, were subsequently covered by middle to late Cenozoic strata that are little deformed. A generalized cross-section across the St. George graben is shown in figure 3. A generalized stratigraphic column based on the COST No. 1 well is shown in figure 4.

Potential Traps

Potential hydrocarbon traps in the St. George graben include faulted anticlines, upthrown fault traps over basement horst blocks, downthrown fault traps along the border faults of the graben, drape of Tertiary strata over basement fault blocks, stratigraphic onlap onto the basement, and possible pinchout of sands.

Potential traps both north and south of the graben include anticlinal structures within the acoustic basement, drape of Tertiary sands over basement highs, fault-bounded traps, and stratigraphic onlap onto basement highs.

Reservoir Formations

The best reservoir rocks encountered in the St. George basin are sandstones of Oligocene age. In the graben, the Arco Y-0511 well encountered fine-grained Oligocene sandstones in beds ranging from 10- to 40-feet thick for a gross total of 460 feet. Porosities ranged from 20 to 30 percent and permeabilities ranged from 20 to 130 millidarcies. The Exxon Y-0527 well had Oligocene sandstones in beds ranging from 5- to 20-feet thick for a gross total of 185 feet. The Exxon Y-0530 and the Chevron Y-0519 wells, also located in the graben, had no sandstones of reservoir quality. Porosity loss with depth tends to be very high in the St. George basin province, because the rocks have a high content of volcanic rock fragments which are diagenetically altered to zeolite and clay minerals with burial.

South of the graben, the best reservoir-rock potential is also in the Oligocene section. The COST No. 1 well contained individual sandstone beds greater than 150 feet thick, with an aggregate total of 1,200 feet. Porosities were as high as 25 percent and permeabilities were as high as 37 millidarcies (Turner and others, 1984a). Permeabilities were as high as 300 to 400 millidarcies in Oligocene sandstones in the Shell Y-0454 well.

Petroleum Source Rock Potential

The source-rock potential is poorly known for the graben, but the COST No. 2 well, located along its southeastern margin, had relatively low TOC values in the Cenozoic and Mesozoic sections (Turner and others, 1984b). The kerogen types identified were gas-prone and the top of the oil window occurs at approximately 12,000 feet. Other unexplored areas of the graben are much deeper and may have better source-rock potential. The Arco Y-0511 well penetrated the northern boundary fault of the graben and recovered samples of Jurassic shale that had TOC values of 0.5 to 2.0 percent. The visual kerogen examination reported a high percentage of amorphous material. If oil-prone source rocks are present in the St. George basin assessment province, they probably occur in Jurassic strata. The province is underlain by the Mesozoic Peninsular terrane which extends from the Cook Inlet area, where Middle Jurassic strata are known to have generated oil (Magoon and Claypool, 1981; Magoon and Anders, 1992).

Source-rock potential in the area south of the graben appears to be poor. The sediments were deposited under oxidizing conditions and are low in TOC. Only gas-prone kerogen types were present in samples from the COST No. 1 well, and the rocks were thermally immature. The oil window occurs at approximately 12,000 feet, so any hypothesized thermally mature hydrocarbon source must involve rocks that lie below the acoustic basement unconformity, the latter generally shallower than 10,000 feet in this play area.

There are no source-rock data for the Pribilof basin. However, seismic data suggest that the basal strata were deposited when the surrounding area was emergent (Comer and others, 1987). Therefore, restricted circulation in the early Tertiary may have been conducive to organic preservation, and strata with good source-rock potential may have been deposited. The oil window probably occurs at about 12,000 feet, so the basal strata should be thermally mature.

Oil and Gas Resources

Four plays with geophysically-mapped prospects have been identified in the assessment province: (1) the St. George graben, (2) the south platform, (3) the north platform, and (4) the Pribilof basin (fig. 2). Data used to model the oil and gas potential

of these plays are tabulated in the play summaries. All four plays were quantitatively assessed using the *GRASP* computer model.

St. George 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	712	2,772
Total Gas (Tcfg)	0.000	2.798	11.145
Total Liquids (Mmbo)	0	214	789
Free Gas** (Tcfg)	0.000	2.756	11.002
Solution Gas (Tcfg)	0.000	0.042	0.143
Oil (Mmbo)	0	109	390
Condensate (Mmbc)	0	105	400
* 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

Table 1 summarizes the 2006 assessment results by commodity for the St. George basin, with detailed results by commodity reported in table 4. Table 2 shows the conditional sizes of the 10 largest pools in the St. George basin assessment province. Table 3 lists the risked, undiscovered technically recoverable oil and gas resources by commodity for the four individual plays. St. George basin assessment results are summarized graphically in figure 5.

The 2006 oil and gas assessment of St. George basin forecast 214 Mmb of oil and condensate and 2.798 Tcf of gas (mean,

risked, technically recoverable resources). At mean values, gas comprises 70 percent of the resource endowment of St. George basin. Oil and condensate resources range up to 789 Mmb and gas resources range up to 11.145 Tcf at fractile F05 (5% chance).

St. George Basin OCS Planning Area, Alaska, 2006 Assessment, Conditional BOE Sizes of Ten Largest Pools				
Assessment Results as of November 2005				
Pool Rank	Play Number	BOE Resources * (Mmboe)		
		F95	Mean	F05
1	2	19	268	869
2	3	14	194	640
3	4	30	157	431
4	1	40	153	449
5	2	7	84	269
6	4	15	75	182
7	1	24	74	155
8	3	5.1	64	207
9	1	16	50	103
10	4	10	47	111
* 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

The four plays in St. George basin are estimated to contain a maximum of 75 pools. These are predominantly gas pools with a minority fraction of mixed (oil and gas) pools. The largest pool in St. George basin contains a mean conditional resource of 268 Mmboe with a maximum (F05) conditional resource of 869 Mmboe. Converting these volumes to an all-gas case, the largest pool in St. George basin contains a mean conditional resource of 1.506 Tcfge, with a maximum (F05) conditional resource of 4.884 Tcfge. Only four pools have mean conditional resources exceeding 100 Mmboe (or 0.562 Tcfge).

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Marlow, M.S., and Cooper, A.K., 1980, Mesozoic and Cenozoic structural trends under southern Bering Sea shelf: American Association of Petroleum Geologists Bulletin, v. 64, p. 2139-2155.

Scholl, D.W., and Hopkins, D.M., 1969, Newly discovered Cenozoic basins, Bering Sea shelf, Alaska: American Association of Petroleum Geologists Bulletin, v. 53, p. 2067-2078.

Scholl, D.W., Vallier, T.L., and Stevenson, A.J., 1983, Geologic evolution of the Aleutian Ridge-Implications for petroleum resources: Alaska Geological Society Journal, v. 3, p. 33-46.

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Worrall, D.M., 1991, Tectonic history of the Bering Sea and the evolution of Tertiary strike-slip basins of the Bering Sea: Geological Society of America Special Paper 257, 120 p.

Links to Summaries for Individual Plays and Appended Items

Play 1, (St. George Graben), St. George Basin, Assessment Summary

Play 2, (South Platform), St. George Basin, Assessment Summary

Play 3, (North Platform), St. George Basin, Assessment Summary

Play 4, (Pribilof Basin), St. George Basin, Assessment Summary

St. George Basin Plays-Assessment Results by Commodity (Excel Format)

St. George Basin Plays-Input Data Tables (Excel Format)

St. George Basin Plays-Pool Size Models (Txt Format)

St. George Basin Plays-Simulation Pools-Statistics (Excel Format)

St. George Basin Province-Assessment Results (Excel Format)

2006 Assessment Results for St. George Basin OCS Planning Area
Risked, Undiscovered, Technically Recoverable Oil and Gas Resources, as of November 2005

Play Number	Play Name	BOE Resources (Mmbo)			Oil Resources (Mmbo)			Gas-Condensate Liquid Resources (Mmbo)			Free* Gas Resources (Tcfg)			Solution Gas Resources (Tcfg)			Total Liquid Resources (Mmbo)			Total Gas Resources (Tcfg)		
		F95	Mean	F05	F95	Mean	F05	F95	Mean	F05	F95	Mean	F05	F95	Mean	F05	F95	Mean	F05	F95	Mean	F05
1	Graben	0	234	698	0	37	92	0	44	136	0.000	0.841	2.590	0.000	0.020	0.052	0	81	228	0.000	0.860	2.642
2	South Platform	0	194	870	0	14	39	0	22	104	0.000	0.880	4.074	0.000	0.005	0.013	0	36	143	0.000	0.885	4.086
3	North Platform	0	145	653	0	23	118	0	15	67	0.000	0.592	2.593	0.000	0.008	0.041	0	38	184	0.000	0.600	2.634
4	Pribilof Basin	0	139	551	0	35	141	0	23	93	0.000	0.444	1.746	0.000	0.009	0.038	0	59	233	0.000	0.453	1.784
	Sum of All Plays**	0	712	2,772	0	109	390	0	105	400	0.000	2.756	11.002	0.000	0.042	0.143	0	214	789	0.000	2.798	11.145

Free gas, occurring as gas caps associated with oil and as oil-free gas pools (non-associated gas).

*** Values as reported out of Basin Level Analysis-Geologic Scenario aggregation module in GRASP, "Volume Ordered" aggregation option. Total liquids and total gas values were obtained by summing resource values for means and fractiles of component commodities. Play resource values are rounded and may not sum to totals reported from basin aggregation.*

BOE, total energy, in millions of barrels (5,620 cubic feet of gas per barrel of oil, energy-equivalent); Mmbo, millions of barrels of oil or liquids; Tcfg, trillions of cubic feet of natural gas

Table 3. Summary of St. George basin province assessment results for ultimate technically recoverable resources (UTRR) by play, 2006 assessment.

Province Resources - Technically Recoverable, Risked, By Product

Geological Resources Assessment Program-GRASP-Version   8.29.2005

The	Current	UAI	AAAAAJ		
	is	for			
World	Level	-	World	Level	Resources
Country	Level	-	UNITED	STATES	OF	AMERICA
Region	Level	-	MMS	-	ALASKA	REGION
Basin	**Level**	**-**	**ST.**	**GEORGE**	**BASIN**

Basin Level Aggregation of Risked, Technically Recoverable Resources By Product (Province Aggregation ".out" file)

Volume Ordered   (Play Aggregation Method)

RandomSeed =   99297

Number   of   Trials   =   10000

Greater Than Percentage	BOE (Mboe)	Oil (Mbo)	Condensate (Mbc)	Solution Gas (Mmcfg)	Free (Gas Cap & Nonassociated) Gas (Mmcfg)
99	0	0	0	0	0
98	0	0	0	0	0
97	0	0	0	0	0
96	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	19,426.87	1,714.71	4,130.12	765.74	75,565.29
55	146,450.10	23,507.46	28,038.60	11,819.89	521,540.85
50	197,844.14	27,297.28	38,374.03	15,031.08	727,780.26
45	375,767.53	50,584.61	65,582.08	23,564.87	1,435,391.88
40	537,697.80	68,566.80	90,327.28	31,181.28	2,097,695.65
35	698,698.02	88,055.64	113,037.68	38,703.55	2,757,834.86
30	866,773.72	112,992.17	137,302.94	46,995.12	3,417,614.67
25	1,064,654.85	138,639.46	167,109.56	53,401.89	4,211,648.85
20	1,294,272.10	169,248.80	198,941.71	68,103.95	5,136,474.55
15	1,593,828.36	220,196.39	238,511.42	83,510.74	6,295,866.72
10	2,012,573.97	325,298.49	286,838.33	124,599.05	7,745,857.78
5	2,772,184.10	389,513.44	399,540.21	143,298.02	11,001,895.13
4	3,068,196.57	550,359.53	417,200.57	199,048.96	11,606,528.03
3	3,448,034.78	526,431.75	483,585.28	193,464.82	13,508,194.98
2	4,008,888.50	684,364.62	541,123.56	241,715.31	15,400,994.51
1	5,001,681.55	958,173.72	652,705.47	341,831.67	18,714,477.64
Mean	712,424.55	109,266.67	105,224.46	42,044.44	2,756,341.37
Rep	712,547.66	78,679.43	111,658.51	24,897.08	2,909,921.59
Min	0	0	0	0	0
Max	13,420,262.85	499,317.08	2,118,392.99	236,404.55	60,473,942.08

Table 4. Detailed report of ultimate technically recoverable resources (UTRR) by commodity, as reported in province aggregation file by *GRASP* computer model, 2006 assessment.
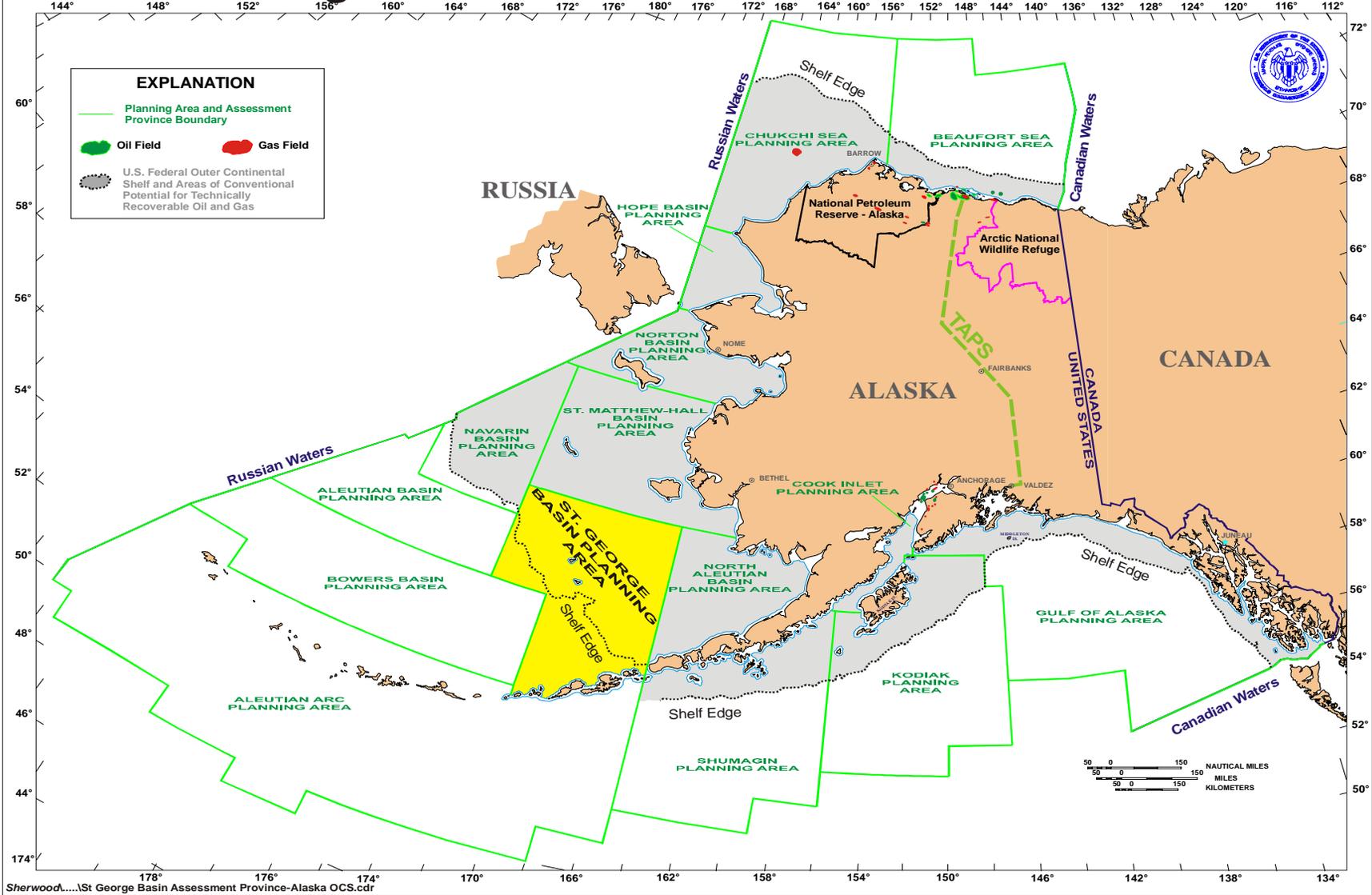
Figure 1. Location of St. George Basin and 2006 assessment province.

Map labels and text:

171° 30' 171° 00' 169° 00' 167° 00' 165° 00'

57° 30'

56° 00'

54° 30'

BERING SEA

St. Paul Island

St. George Island

PLAY 4

PRIBILOF BASIN

PLAY 3 NORTH PLATFORM

PLAY 1 ST. GEORGE GRABEN

PLAY 2 SOUTH PLATFORM

Pribilof Canyon

100 m

200 m

Area of map

COST 1

COST 2

Fault - Hatchures on downthrown side

Bathymetry in meters

Plugged and abandoned well

EXPLORATORY WELLS

OPERATOR	LEASE NUMBER	DEPTH(FT)
1 CHEVRON	Y-0519	11,595
2 EXXON	Y-0530	8,800
3 EXXON	Y-0527	12,433
4 ARCO	Y-0537	12,456
5 ARCO	Y-0511	10,860
	Y-0511A	13,937
6 GULF	Y-0477	12,467
7 MOBIL	Y-0466	9,592
8 SHELL	Y-0545	10,277
9 SHELL	Y-0463	8,510

0 50 MILES

0 50 KILOMETERS

Figure 2. Map showing locations of the St. George graben, Pribilof basin, major faults, COST wells, and exploratory wells in the St. George basin assessment province.
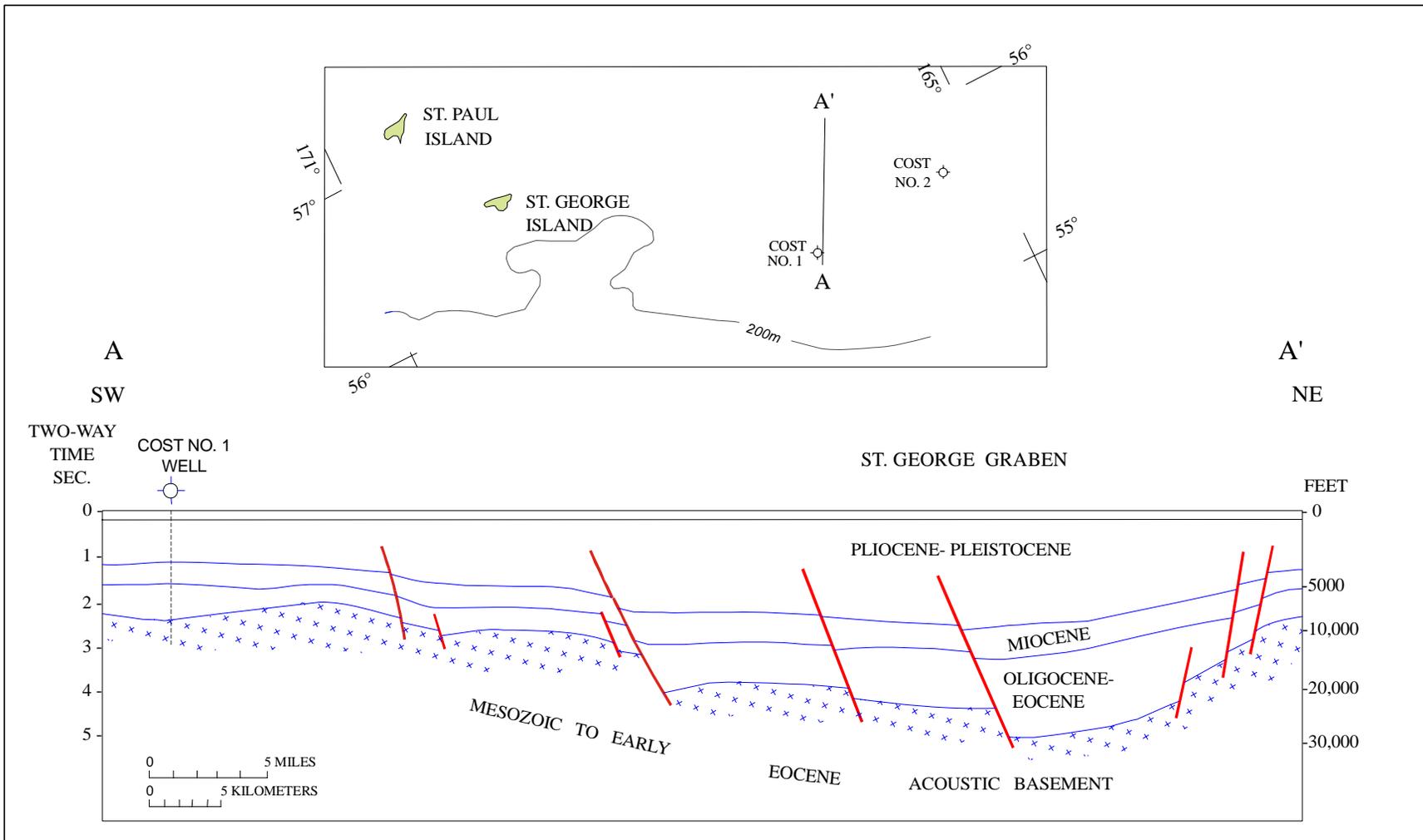
Figure 3. Generalized cross-section of the St. George basin.
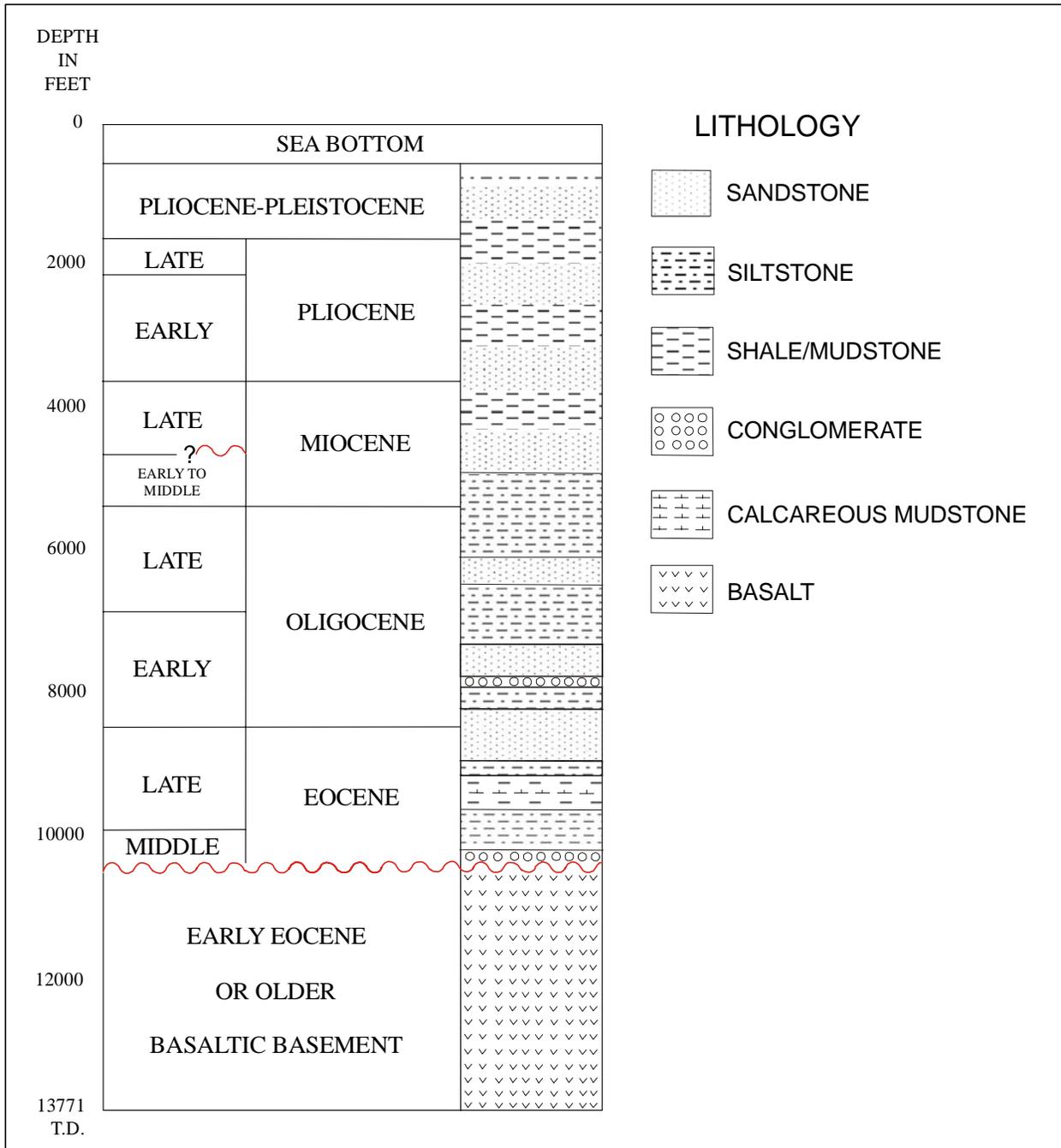
Figure 4. Generalized stratigraphic summary of the St. George basin COST No 1 well.
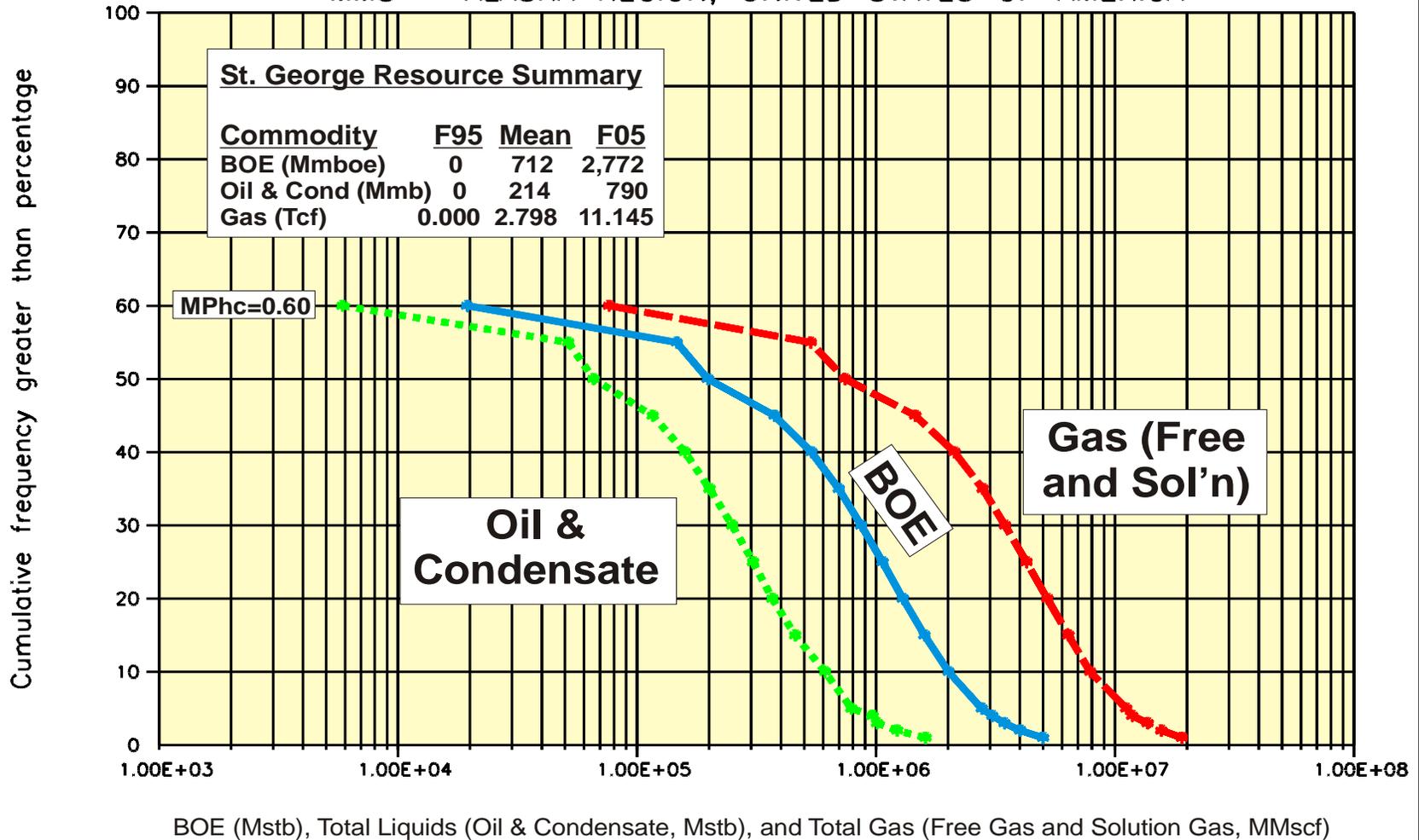
Figure 5. Cumulative probability plot for undiscovered technically recoverable oil and gas resources for St. George Basin Planning Area and assessment province, 2006 assessment.