

MMS

**U.S. Department of the Interior
Minerals Management Service
Alaska OCS Region**

Exploring the Frontier— Alaska's Beaufort Sea

Geographic and Environmental Setting

The water depth in the Beaufort Sea program area is as shallow as five feet and ranges up to 5,900 feet. Most wells were drilled in less than 60 feet, although two wells were drilled in 150 feet of water. The well depths are as shallow as 8,000 feet but have been as deep as 18,300 feet.

Sea ice is an important factor governing drilling, seismic shooting, and logistics. The Beaufort Sea is ice covered from October through June. Lead openings in the ice begin to form in late June and the nearshore is mostly ice free by early August. Drilling generally occurs from about November through May when the ice is solid. In most years ice conditions allow seismic shooting on the ice from February into May and in the open-water from late July into October. Activities have been coordinated to avoid the bowhead whale subsistence hunt in certain locations from September to October.

Leasing in the Beaufort Sea began with the Federal-State of Alaska joint offshore lease sale in December 1979. Six additional lease sales were held. The last lease sale was held in 1998. These sales leased over 3.4 million acres and generated nearly \$4 billion in bonus bids. Presently 54 leases remain active.

Data Availability

A wealth of non-exclusive geophysical data is available for the Beaufort Sea planning area. Western Geophysical Corporation (WGC) collected 137 square miles of non-exclusive three-dimensional seismic in 1999 and 2000. Sixteen thousand line miles of non-exclusive two-dimensional seismic were collected by WGC, Geophysical Service Incorporated (GSI), and Energy Analysts from 1983 through 1990. WGC and GSI collected 8,700 line miles of non-exclusive gravity and magnetic data from 1983 through 1985.

The MMS Alaska office has data available to the public for 29 of the 30 exploration wells in the Beaufort Sea program area, including well logs, core reports, production tests, and well histories. The Alaska Geologic Materials Center has core chips, cuttings, thin sections, and cores from most of the exploration wells. The deepest federal well, Aurora, penetrated 18,300 feet of vertical section.

Hydrocarbon Discoveries

A total of 30 OCS exploration wells tested prospects from the Sagavanirktok Formation through the Endicott Group. Drilling led to five oil field discoveries. The Northstar field with recoverable reserves of 176 Mmbo was delineated with five exploration wells. It is producing at its design capacity of 65,000 barrels per day. The Liberty field with 120 Mmbo of recoverable reserves was delineated with three exploration wells and one appraisal well. The Hammerhead field was delineated with two exploration wells and has 100 to 200+ Mmbo¹. The Kuvlum field was delineated with three exploration wells and has 160 to 300+ Mmbo. The Sandpiper field was delineated with two exploration wells and has 12 Mmb of oil and condensate. The Hammerhead, Kuvlum, and Sandpiper fields are available for leasing in the upcoming sale. In addition, the Mukluk, Antares,

¹ Accurate oil volumes for individual fields generally are preliminary estimates, as these discoveries have not been adequately delineated or studied for their development potential. Most of these discoveries are noncommercial at the present time and will require new technology or higher oil prices to be economic. Future development likely would occur in conjunction with the construction of new infrastructure to nearby, future discoveries of commercial size.

and Phoenix wells encountered minor amounts of oil, and the Galahad well encountered minor amounts of gas and an oil show.

Current infrastructure includes onshore oil pipelines from the Alpine to the Badami fields with plans to extend the pipeline east to the Point Thomson field. The Northstar, Endicott, and Point McIntyre fields have extended the pipeline infrastructure offshore. The pipelines tie into the pump station at Prudhoe Bay that feeds into the Trans-Alaska Pipeline.

Basin Description

The Beaufort Sea program area is an offshore extension of the proven North Slope petroleum province and the area has the same thick reservoir sands seen at the Prudhoe Bay and nearby fields. The reservoirs for the commercial fields are thick sandstones of the Ellesmerian and Rift sequences. The reservoirs at Prudhoe Bay are in the quartz-rich sandstones of the Sadlerochit Group. The reservoirs at the Kuparuk, Point McIntyre, Milne Point, and Niakuk fields are in marine sandstones of the Kuparuk Formation. The Endicott field's reservoir is in the fluvial sandstones of the Endicott Group. Carbonate reservoirs occur in the Lisburne Field.

The younger Brookian Sequence reservoirs occur in deltaic sands of the Torok through Sagavanirktok formations. They are generally thinner than those in the underlying sequences. In the western part of the Province, the Nanushuk and Colville groups have poor quality reservoirs due to the high clay content of the deltaic sandstones. Reservoir quality in the Torok Formation

is poor due to the fine grained nature of the Nanushuk deltaic system that delivered sand to the shelf break. In the central part of the province, excellent reservoir high quality sands occur within the Sagavanirktok Formation in most coastal wells and quality reservoir rocks probably extend into the offshore. Sagavanirktok discoveries (West Sak and Schrader Bluff pools) contain heavy hydrocarbons. Reservoirs in the Canning Formation include turbidite sands in submarine fan environments enclosed in prodelta shale.

The source rocks are a mixture of the rich sources that filled Prudhoe Bay plus source rocks with lighter oil fractions that have filled the Northstar and Sandpiper fields with 40 + API gravity oil. The Shublik Formation and Kingak Shale in the Ellesmerian Sequence are the primary source rocks for the all the commercial hydrocarbons on the North Slope. The Pebble shale also has oil source potential.

Assessment Results

MMS has identified 300 prospects distributed through 14 plays within the planning area. The MMS database also assesses resources in prospects that are as yet unidentified, based on

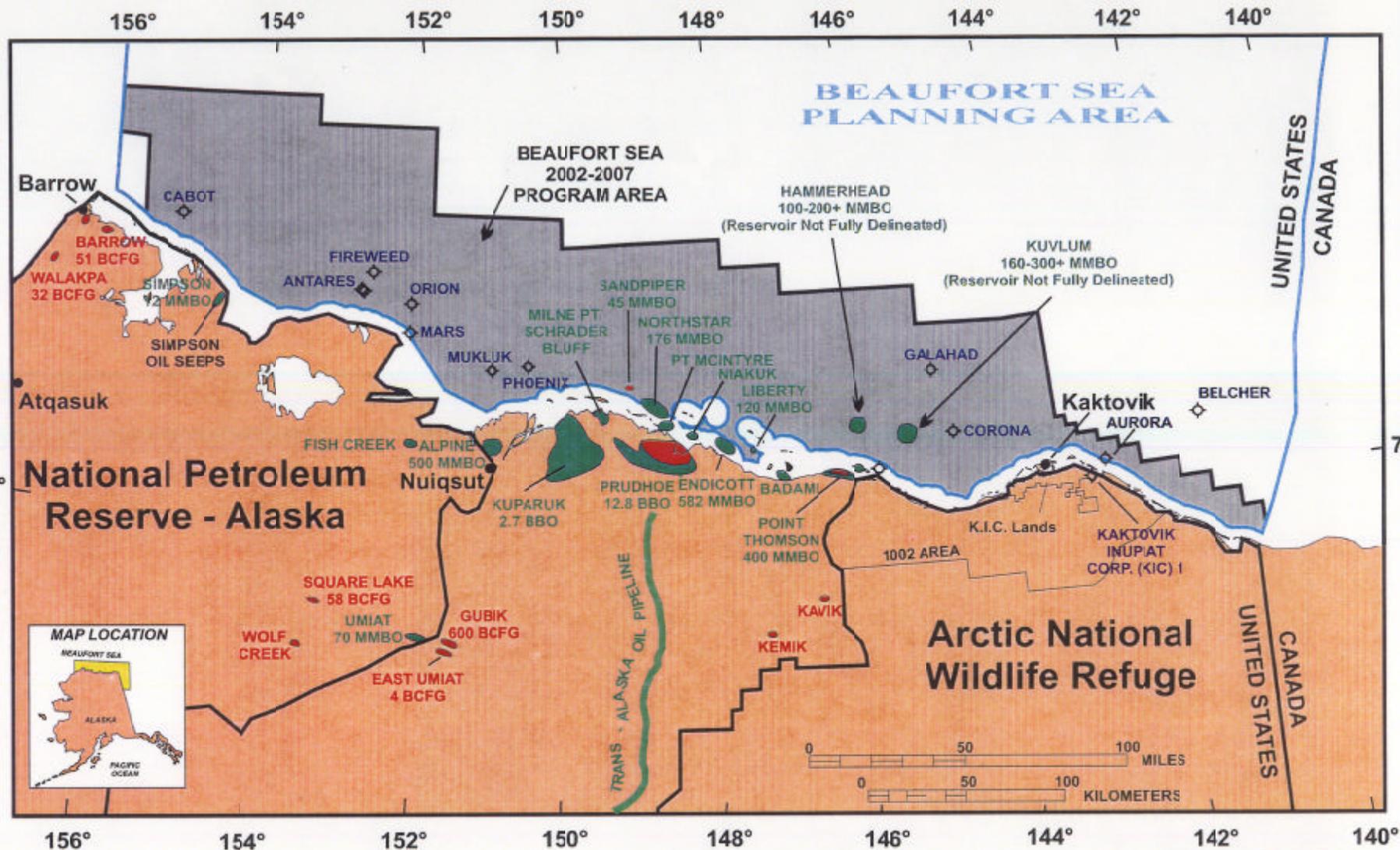
currently available seismic data. Combined with information from exploratory drilling, the resource model for the Beaufort Sea planning area estimates 271 undiscovered petroleum pools (oil, gas, and mixture).

In the Beaufort Sea planning area, the undiscovered conventionally recoverable mean resources are 6.94 billion barrels of oil (BBO) and 32.07 trillion cubic feet of gas (TCFG). When the 158 oil pools are ranked by size and graphed, the rank plot shows that the largest oil pool has a mean resource of 1.021 BBO. The rank plot of the 250 gas pools shows that the largest gas pool has a mean resource of 6.908 TCFG. The price-supply graph summarizes economic results and shows the economically recoverable oil and gas at various prices. At oil prices of \$18/bbl and \$30/bbl, the economic model estimates economically recoverable mean (average) values of 1.78 BBO and 3.24 BBO, respectively, for the planning area. The high side potential for the planning area ranges from 6.64 to 7.76 BBO (\$18/bbl to \$30/bbl).

**Beaufort Sea Planning Area
RISKED, UNDISCOVERED OIL AND GAS**

RESOURCE CATEGORY	OIL AND NGL (Bbo)			GAS (Tcfg)		
	F ₉₅	MEAN	F ₀₅	F ₉₅	MEAN	F ₀₅
CONVENTIONALLY RECOVERABLE	3.56	6.94	11.84	12.86	32.07	63.27
ECONOMICALLY RECOVERABLE AT \$18/BBL OIL PRICE (and \$2.11/mcf GAS PRICE)	0.00	1.78	6.64	0.00	2.93	9.68
ECONOMICALLY RECOVERABLE AT \$30/BBL OIL PRICE (and \$3.52/mcf GAS PRICE)	1.00	3.24	7.76	0.64	4.20	10.67

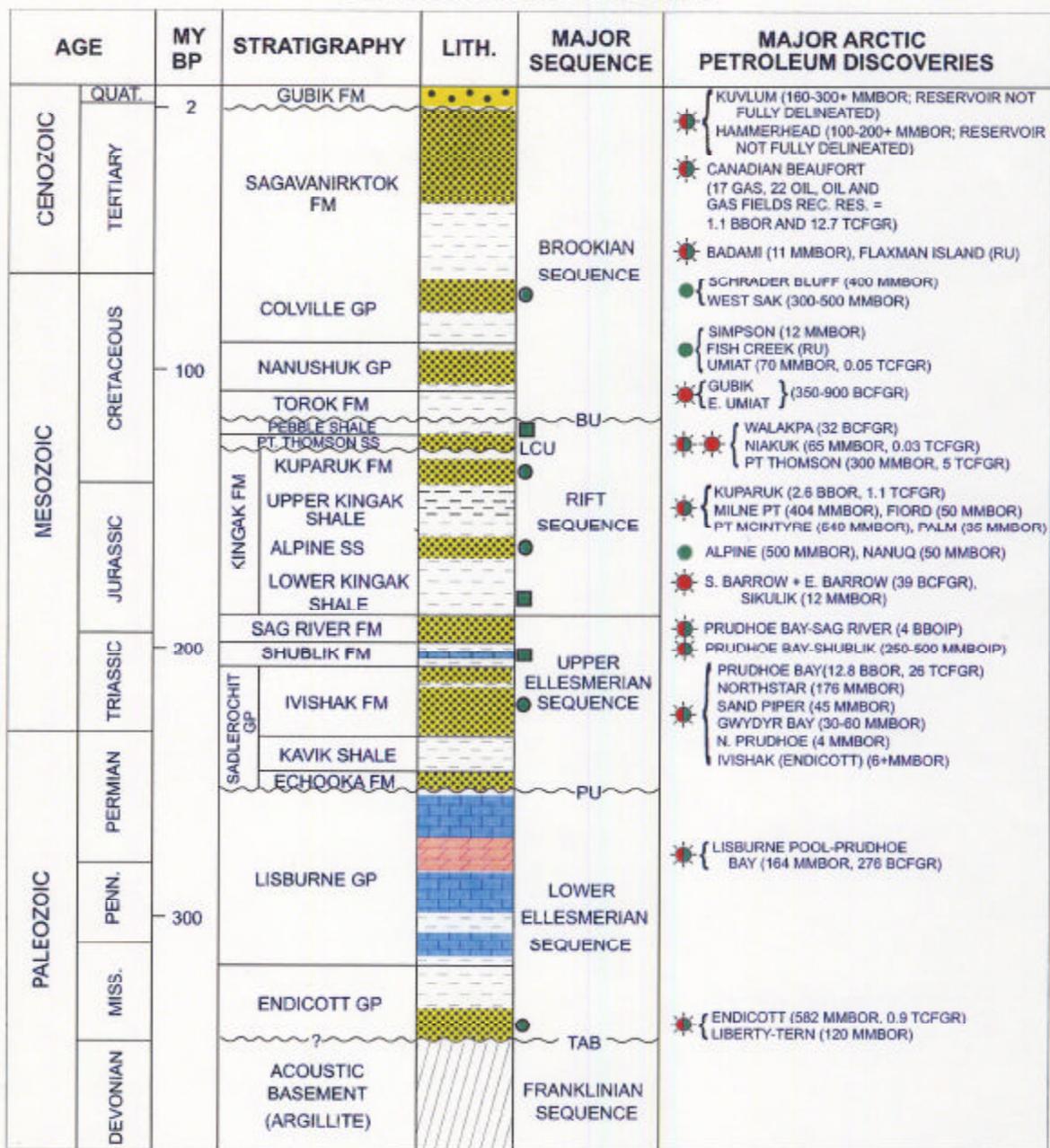
BEAUFORT SEA PROGRAM AREA



EXPLANATION

	EXPLORATION WELL, PLUGGED AND ABANDONED	MMBO	MILLIONS OF BARRELS OF OIL, RECOVERABLE		2002-2007 PROGRAM AREA WITHIN OCS PLANNING AREA
	OIL FIELD	BBO	BILLIONS OF BARRELS OF OIL, RECOVERABLE		DCS PLANNING AREA
	GAS FIELD	BCFG	BILLIONS OF CUBIC FEET OF GAS, RECOVERABLE		
	GAS FIELD	TCFG	TRILLIONS OF CUBIC FEET OF GAS, RECOVERABLE		

BEAUFORT SEA PLANNING AREA STRATIGRAPHIC COLUMN



EXPLANATION

BU: BROOKIAN UNCONFORMITY
 LCU: LOWER CRETACEOUS UNCONFORMITY
 PU: PERMIAN UNCONFORMITY
 TAB: TOP OF ACOUSTIC BASEMENT
 ● IDENTIFIED POTENTIAL OIL RESERVOIRS
 ■ IDENTIFIED OIL SOURCE ROCKS

SANDSTONE
 CONGLOMERATE
 SHALE
 SILTSTONE
 LIMESTONE
 DOLOMITE
 METAMORPHIC

● OIL FIELD (RESERVES)
 GAS FIELD (RESERVES)
 OIL AND GAS FIELDS (RESERVES)

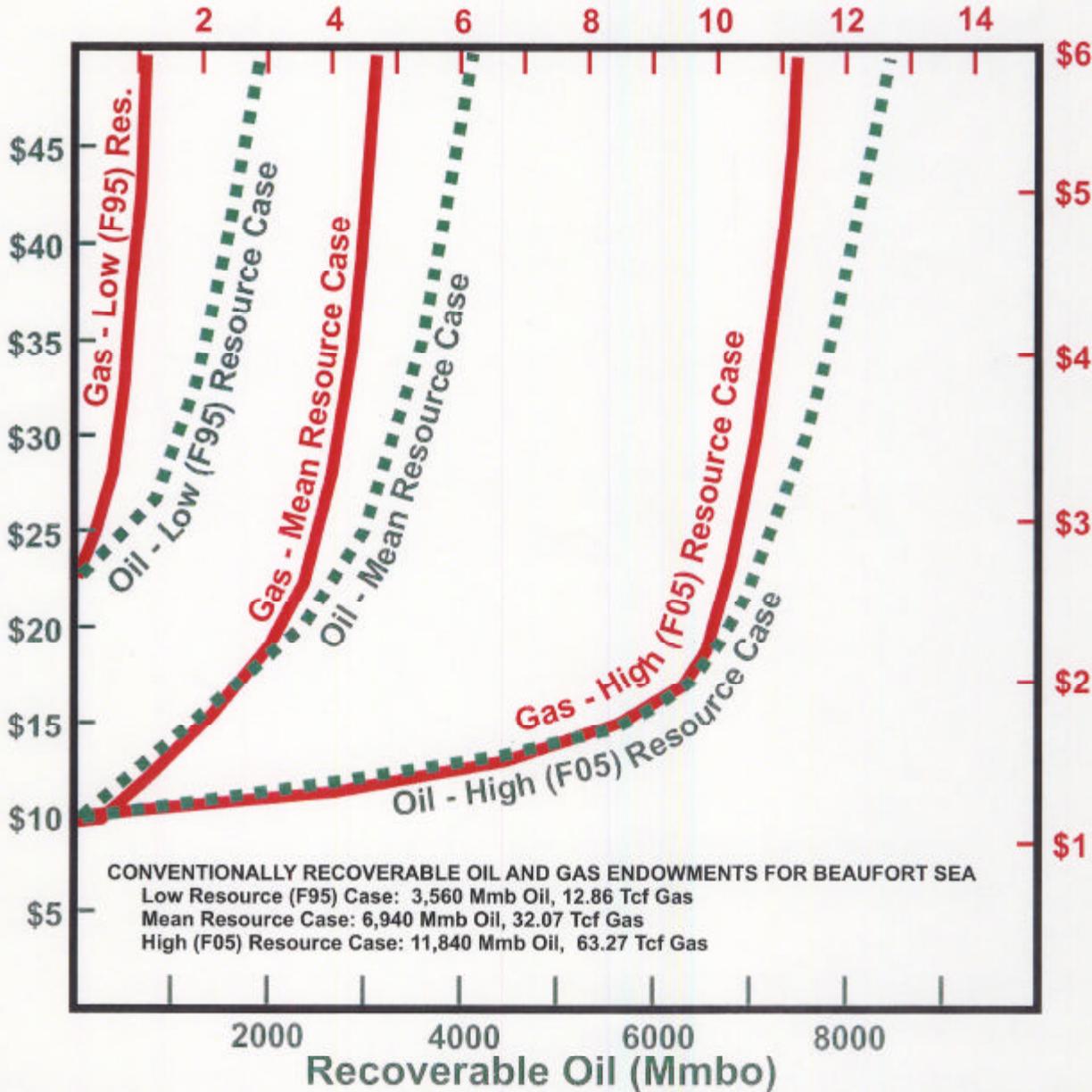
MMBOR: MILLIONS OF BARRELS OF OIL, RECOVERABLE
 MMBOIP: MILLIONS OF BARRELS OF OIL, IN PLACE
 BBOR: BILLIONS OF BARRELS OF OIL, RECOVERABLE
 BCFGR: BILLION CUBIC FEET OF GAS, RECOVERABLE
 TCFGR: TRILLION CUBIC FEET OF GAS, RECOVERABLE
 RU: RESERVES UNKNOWN

BEAUFORT SEA PLANNING AREA ECONOMICALLY RECOVERABLE OIL AND GAS

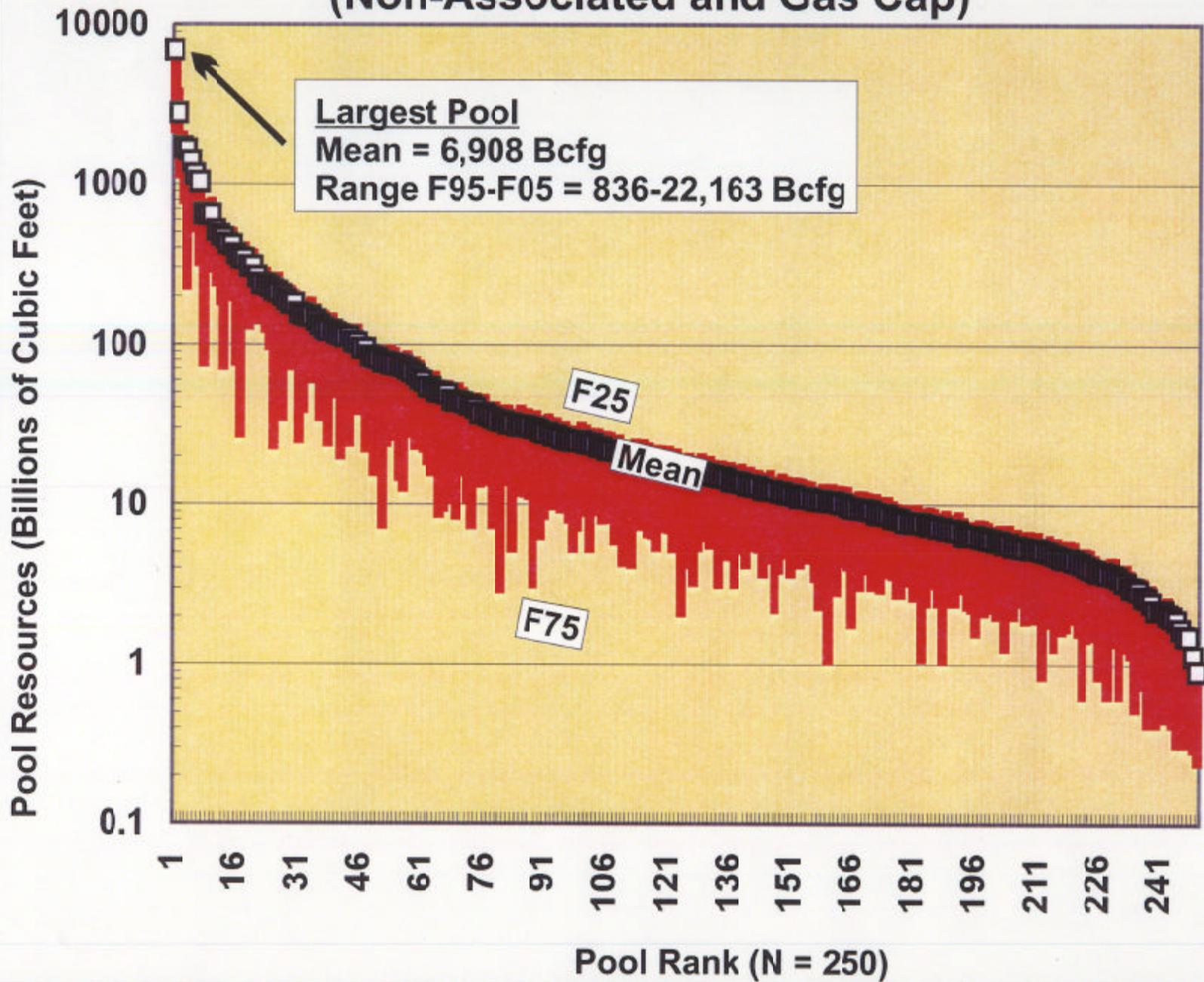
Recoverable Gas (Tcf)

OIL PRICE (\$/bbl) AT U.S. WEST COAST

GAS PRICE (\$/mcf) AT PRUDHOE BAY



Undiscovered Gas Pools for Beaufort Sea Planning Area (Non-Associated and Gas Cap)



Undiscovered Oil Pools for Beaufort Sea Planning Area

