

# MMS

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

## Exploring the Frontier— Chukchi Sea and Hope Basin

### *Geographic and Environmental Setting*

The Chukchi Sea and Hope Basin 2002-2007 program areas lie offshore northwestern Alaska in waters of Chukchi Sea and Kotzebue Sound. The program areas are located within larger “planning areas” that extend west from the three-mile offshore State of Alaska boundary to Russian waters (west of 169° west longitude). The extremely remote part of the Chukchi Sea planning area north of 73° north latitude is excluded from the 2002-2007 program area. A 12- to 50-mile wide area of spring whale migrations that follows early leads within sea ice along the Alaska coast north of Cape Lisburne is excluded from the Chukchi Sea program area as the “Deferred Polynya Zone.” The Hope Basin 2002-2007 program area captures the most attractive (from an exploration standpoint) northern part of Hope Basin planning area.

Water depths on the Chukchi shelf and in Kotzebue Sound are typically 160 feet or less. The Arctic ice pack covers the Chukchi shelf and moves westerly north of Cape Lisburne during winter months. Iceberg-keel seafloor-gouges up to 16 feet deep are observed on the Chukchi

shelf in waters less than 200 feet deep but are generally absent south of Cape Lisburne. Seasonal ice cover typically withdraws northward to the north edge of the Chukchi Sea program area during the time of maximum ice retreat in late September. Past drilling and seismic data acquisition in the Chukchi Sea have occurred in the open-water period extending from early July to mid-October. Four lease sales were held on the Chukchi shelf in 1988 and 1991. The sales issued 483 leases encompassing approximately 2.7 million acres for \$512 million in high-bonus bids. All leases were relinquished by 1996.

### *Data Availability*

Five wells were drilled on the Chukchi shelf from 1989 to 1991 and sampled formations as old as Mississippian (Lisburne Group). Two wells were drilled in 1974-75 on State of Alaska lands surrounding Kotzebue Sound and sampled Tertiary-age rocks correlative to the sedimentary fill in Hope Basin. All of these well data are publicly available. Approximately 100,000 line miles of gridded (spacing typically less than two miles) two-dimensional seismic data were collected by the petroleum industry

on the Chukchi shelf, mostly from 1980 to 1991. Industry surveys also acquired 66,000 line-miles of magnetic and gravity data. Industry acquired 13,500 line-miles of gridded (spacing typically 3 to 5 miles) two-dimensional seismic data in Hope Basin from 1980 to 1984. Most seismic data were acquired for speculative sale and are presently held by Western Geophysical Company. Exxon, Shell, and Amoco acquired exclusive seismic data on the Chukchi shelf.

### ***Hydrocarbon Discoveries***

Numerous oil and gas shows were noted throughout all five Chukchi shelf wells and pooled oil or gas were encountered at four wells. At the Klondike well, oil pay appears to be present in Kuparuk-equivalent sandstones and 35° API gravity oil was swabbed into the well bore from the Shublik Formation. Wireline test devices recovered gas and condensate from sandstones in the Burger and Popcorn wells. The Burger structure is estimated to contain 2-10 trillion cubic feet of discovered gas resources in Kuparuk-equivalent sandstones. Although no commercial petroleum accumulations were discovered, the Chukchi shelf wells demonstrate widespread pooled hydrocarbons along the margins of Hanna Trough. North Chukchi Basin, north of the Hinge Line, was not penetrated by any wells, although correlative strata were sampled by Popcorn, Crackerjack, and Klondike wells. Kotzebue Basin, an eastern extension of Hope Basin, was tested by the Cape Espenberg and Nimiuk Point wells, which did not encounter any shows or accumulations of oil or gas.

### ***Basin Descriptions***

North Chukchi and Nuwuk Basins underlie the northernmost part of the Chukchi Sea planning area. Both basins mark rifts that split northern Alaska away from more northern lands. North of the Hinge Line, these basins are filled with over 40,000 feet of Cretaceous and Tertiary strata.

Hanna Trough, a northern extension of the Arctic Alaska Basin that underlies the North Slope of Alaska, underlies the central parts of the Chukchi Sea program area. Numerous large fault blocks created during basin rifting form prospects in western Hanna Trough. Hanna Trough is locally filled with over 38,000 feet of strata of Paleozoic and Mesozoic ages. The Hanna Trough sedimentary fill is partly correlative to the rich oil source beds and thick reservoir formations that created the 75 billion-barrel (in-place) discovered oil endowment of the North Slope of Alaska. Oil source beds over 1,000 feet thick and partly correlative to the Triassic Shublik Formation were sampled at the Klondike well. Chukchi shelf wells penetrated reservoir formations correlative to the Ivishak Formation (Prudhoe Bay field reservoir, 12.8 billion barrels original reserves), the Kuparuk Formation (Kuparuk field reservoir, 2.6 billion barrels original reserves), the Echooka Formation (575 feet thick at Diamond well), and basal Paleocene sandstones of the Sagavanirktok Formation (540 feet thick at Popcorn well). Hanna Trough is overlain by an independent Cretaceous basin north of the Brooks Range that features large folds involving the Nanushuk Group and Torok Formation.

Seismic mapping on the Chukchi shelf has identified several hundred prospects ranging up to hundreds of thousands of acres in area. The oil and gas encountered by exploration wells, the numerous prospects, the rich oil source beds, and the thick reservoir formations all point to high oil potential for Hanna Trough.

The Hope Basin planning area is underlain by Hope and Kotzebue Basins, highly faulted rift basins that are filled with up to 18,000 feet of Tertiary age strata resting on Paleozoic metamorphic rocks. In the Kotzebue Basin, the Tertiary strata in the Cape Espenberg and Nimiuk Point wells include marine and nonmarine rocks, coals, and abundant volcanic rocks. Over most of the basins, the sedimentary fill is less than 10,000 feet thick and probably does not attain temperatures sufficient to generate petroleum. Therefore, the oil generation potential of Hope Basin is limited and most prospects outside thickness maxima are modeled as charged with biogenic gas.

### ***Assessment Results***

A Year 2000 assessment of the Chukchi Sea planning area estimated that the endowments of conventionally recoverable resources average 15.46 billion barrels of oil and 60.11 trillion cubic feet of gas. The Chukchi Sea resource model estimates hundreds of petroleum pools with a handful that offer oil resources in the multi-billion-barrel range or gas resources in the multi-trillion-cubic-foot range. To be commercially viable, these largest pools must overcome the huge expenses

associated with construction of new transportation infrastructures and field developments. The hypothetical development model for Chukchi Sea assumed construction of a 300-mile overland pipeline from the Trans-Alaska oil pipeline (TAPS) to the northwest coast of Alaska and 250 miles of subsea gathering lines accessing the high-potential areas of Chukchi Sea. Chukchi Sea oil delivered to TAPS is assumed to be landed at existing U.S. West Coast markets at prevailing TAPS pipeline and shipping tariff rates. A price-supply graph summarizes the economic results and indicates that about 1 billion barrels (risked) are economically recoverable at the \$18/bbl mean or average level; 6.1 billion barrels (risked) are economically recoverable at \$30/bbl mean level. The high side oil potential ranges from 7.2 to 11 billion barrels (\$18/bbl to \$30/bbl). The oil development model for Chukchi Sea assumes that gas is retained at leases for field use and enhanced oil recovery.

The Hope Basin planning area is estimated to contain endowments of conventionally recoverable resources averaging 0.09 billion barrels of (mostly) natural gas liquids and 3.38 trillion cubic feet of gas. The Hope Basin resource model estimates over 150 pools of (mostly) gas, with a few pools in the multi-trillion-cubic-foot range. The hypothetical development model for Hope Basin assumed construction of subsea pipelines from high-potential areas to a receiving facility at the Red Dog Mine port dock at Kivalina. Kivalina was assumed to be the market point for gas taken to the Red Dog zinc mine (gas to replace imported diesel fuel) or other hypothetical industrial customers at Kivalina. Tankers carry natural gas

liquids obtained by hypothetical gas development to refineries in Cook Inlet. A price-supply graph summarizes the results of economic modeling and indicates that 610 billion cubic feet (risked) of gas are economically recoverable at \$2.11/mcf (mean case);

1,510 billion cubic feet (risked) of gas are economically recoverable at \$3.52/mcf (mean case). The Hope Basin high side gas potential ranges from 4,870 to 6,020 billion cubic feet (\$2.11/mcf to \$3.52/mcf).

**CHUKCHI SEA PLANNING AREA  
RISKED, UNDISCOVERED OIL AND GAS  
[Oil Delivered to U.S. West Coast Market]**

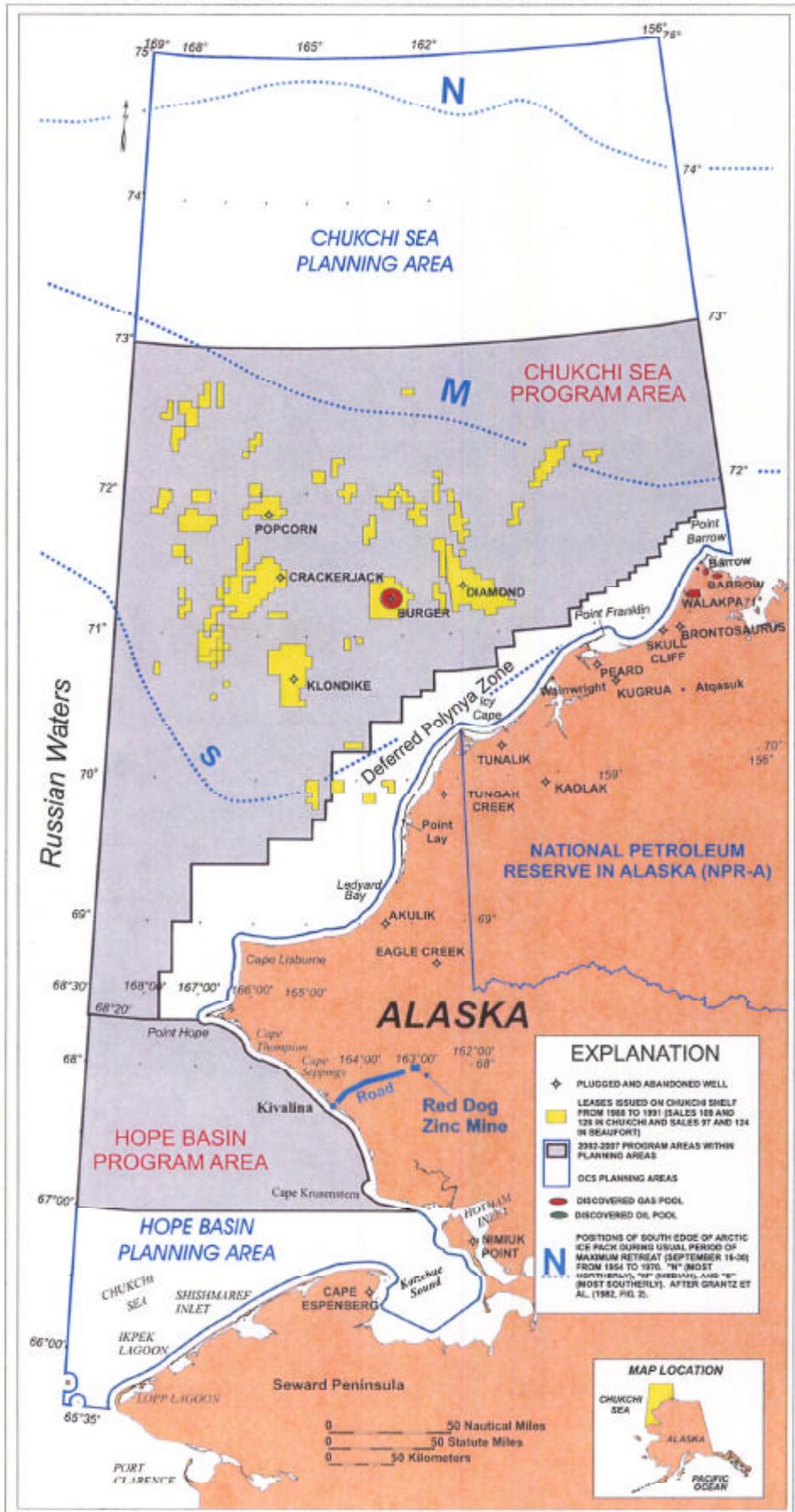
RESOURCE CATEGORY	OIL AND NGL (Bbo)			GAS (Tcfg)		
	F <sub>95</sub>	MEAN	F <sub>05</sub>	F <sub>95</sub>	MEAN	F <sub>05</sub>
CONVENTIONALLY RECOVERABLE	8.60	15.46	25.03	13.56	60.11	154.31
ECONOMICALLY RECOVERABLE AT \$18/BBL OIL PRICE (and \$2.11/mcf GAS PRICE)	0.00	0.97	7.20	NA	NA	NA
ECONOMICALLY RECOVERABLE AT \$30/BBL OIL PRICE (and \$3.52/mcf GAS PRICE)	1.42	6.11	10.96	NA	NA	NA

*NA: not assessed; gas is not economic in the near term*

**HOPE BASIN PLANNING AREA  
RISKED, UNDISCOVERED GAS AND NGL  
(Delivered to Hypothetical Market at Kivalina)**

RESOURCE CATEGORY	OIL AND NGL (Bbo)			GAS (Tcfg)		
	F <sub>95</sub>	MEAN	F <sub>05</sub>	F <sub>95</sub>	MEAN	F <sub>05</sub>
CONVENTIONALLY RECOVERABLE	0.00	0.09	0.28	0.00	3.38	11.06
ECONOMICALLY RECOVERABLE AT \$18/BBL OIL PRICE (and \$2.11/mcf GAS PRICE)	0.00	0.02	0.14	0.00	0.61	4.87
ECONOMICALLY RECOVERABLE AT \$30/BBL OIL PRICE (and \$3.52/mcf GAS PRICE)	0.00	0.04	0.16	0.00	1.51	6.02

# CHUKCHI SEA AND HOPE BASIN PROGRAM AREAS AND PLANNING AREAS

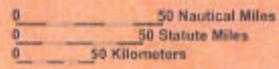


### EXPLANATION

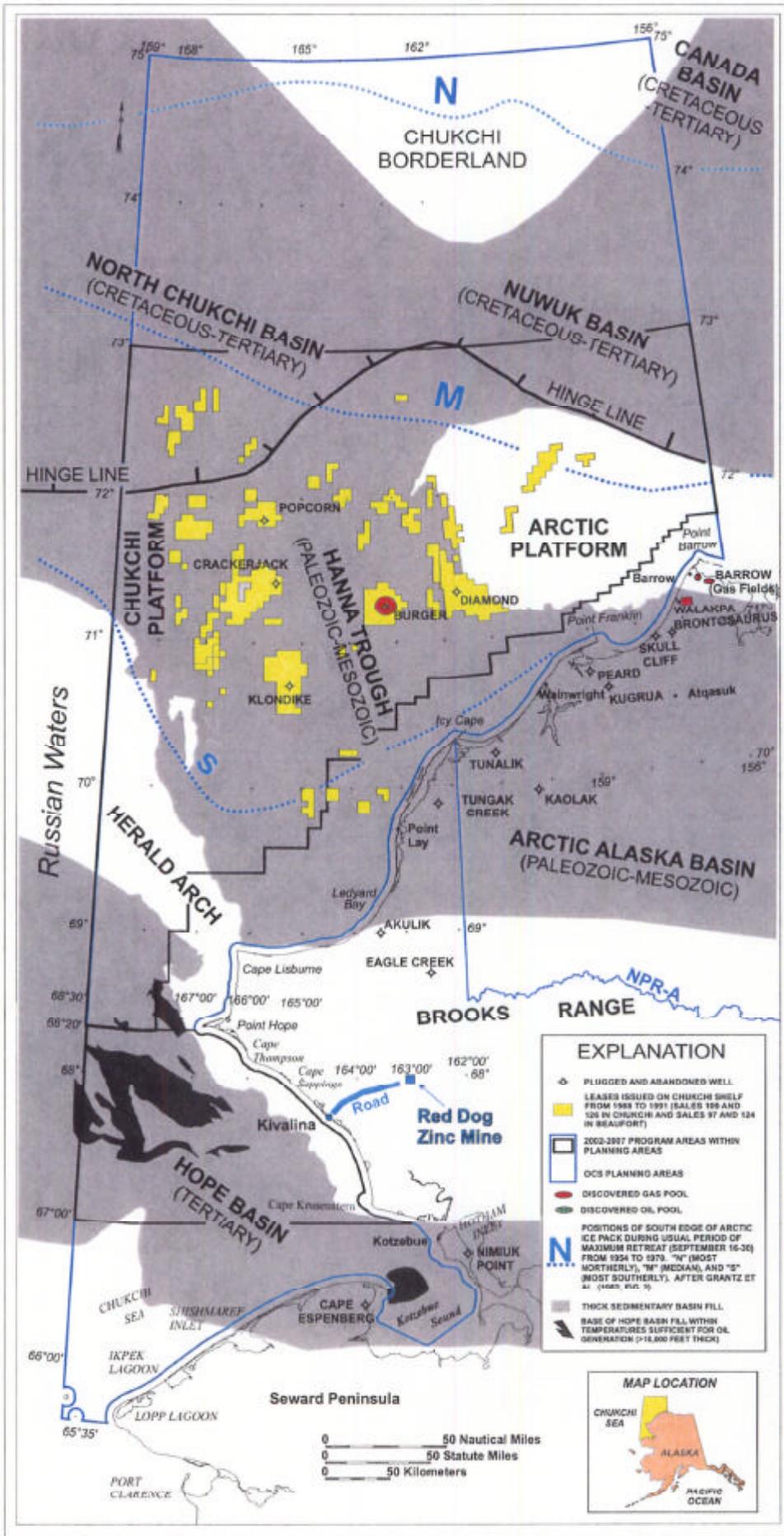
- ◆ PLUGGED AND ABANDONED WELL
- LEASES ISSUED ON CHUKCHI SHELF FROM 1988 TO 1991 (SALES 108 AND 126 IN CHUKCHI AND SALES 97 AND 124 IN BEAUFORT)
- 2092-2097 PROGRAM AREAS WITHIN PLANNING AREAS
- OCS PLANNING AREAS
- DISCOVERED GAS POOL
- DISCOVERED OIL POOL

POSITIONS OF SOUTH EDGE OF ARCTIC ICE PACK DURING USUAL PERIOD OF MAXIMUM RETREAT (SEPTEMBER 18-06) FROM 1854 TO 1970. "N" (MOST NORTHERLY), "M" (MIDDLE), AND "S" (MOST SOUTHERLY), AFTER GRANTZ ET AL. (1982, FIG. 2).

### MAP LOCATION



# CHUKCHI SEA AND KOTZEBUE SOUND SEDIMENTARY BASINS

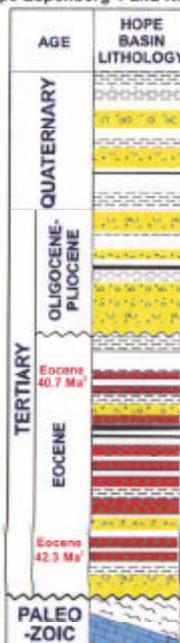


# STRATIGRAPHIC COLUMNS

## HOPE BASIN

Hope and Kotzebue Basins

(Based on Cape Espenberg 1 and Niimiuk Pt 1 Wells)<sup>1</sup>



### HOPE BASIN EXPLANATION

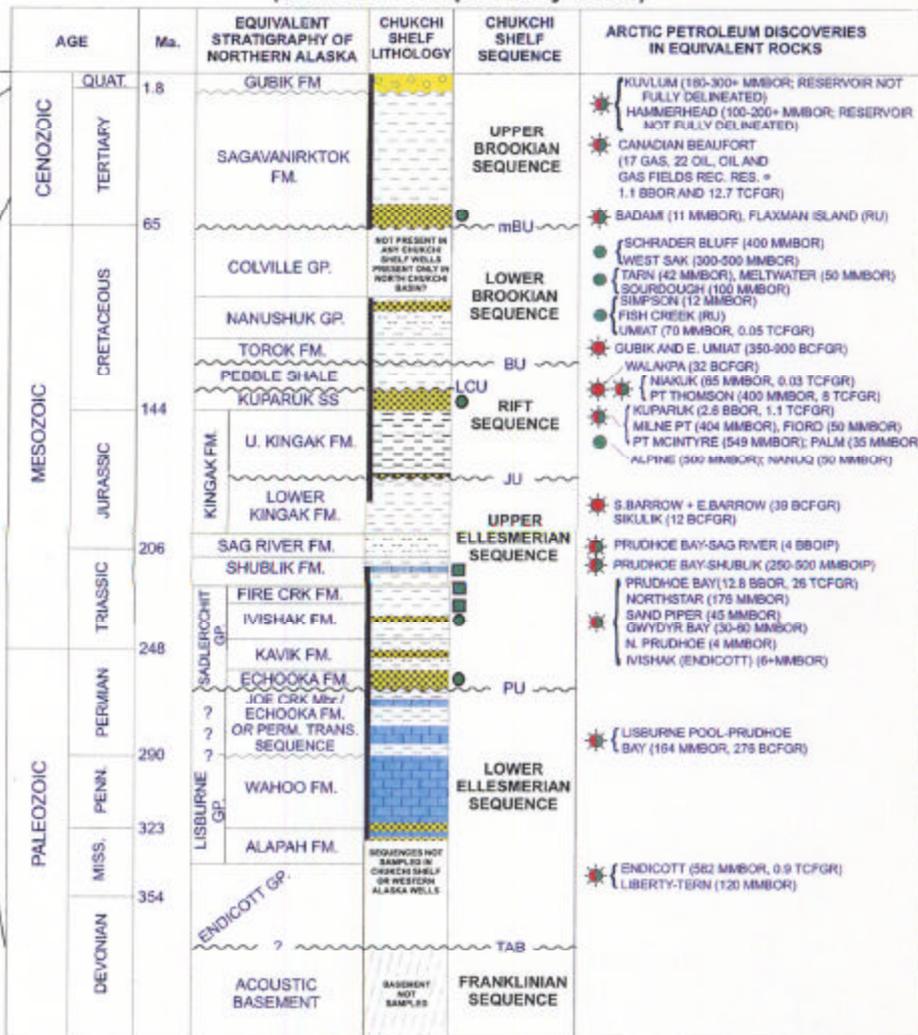


<sup>1</sup> Paleontological data by Anderson, Warren and Associates (08 Aug 1978) and reported by Mobil Exploration (with geochemistry report filed with Alaska Oil and Gas Conservation Commission (Rept. 15, 1981))

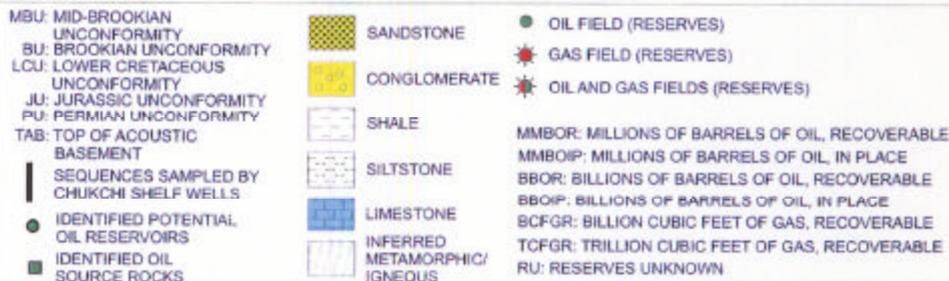
<sup>2</sup> Radiometric dates by Roger Devison (1982) and reported by Tolson (1987, fig. 3).

## CHUKCHI SEA

(Based on 5 Exploratory Wells)



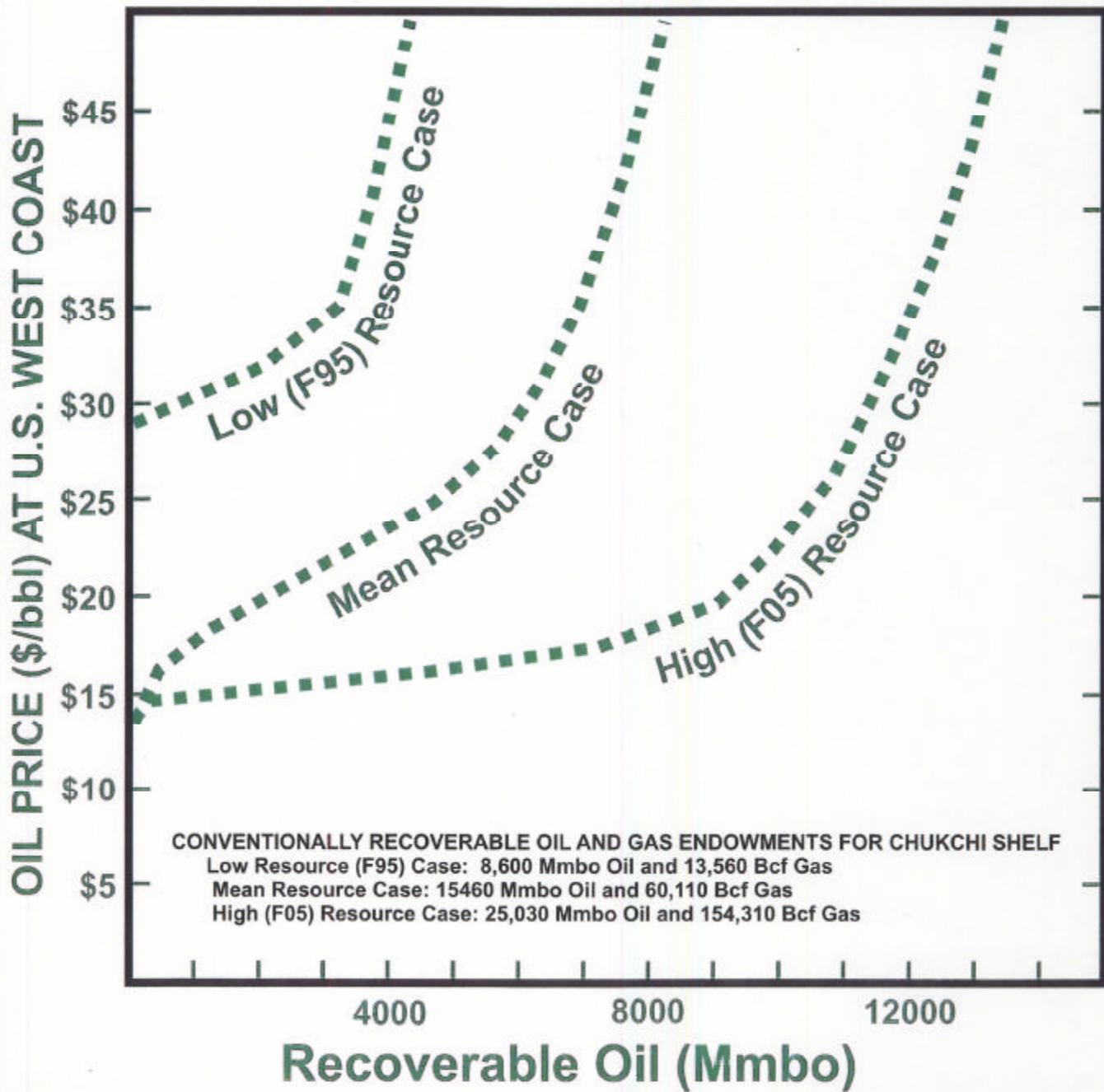
### CHUKCHI SEA EXPLANATION



# CHUKCHI SEA PLANNING AREA

## ECONOMICALLY RECOVERABLE OIL

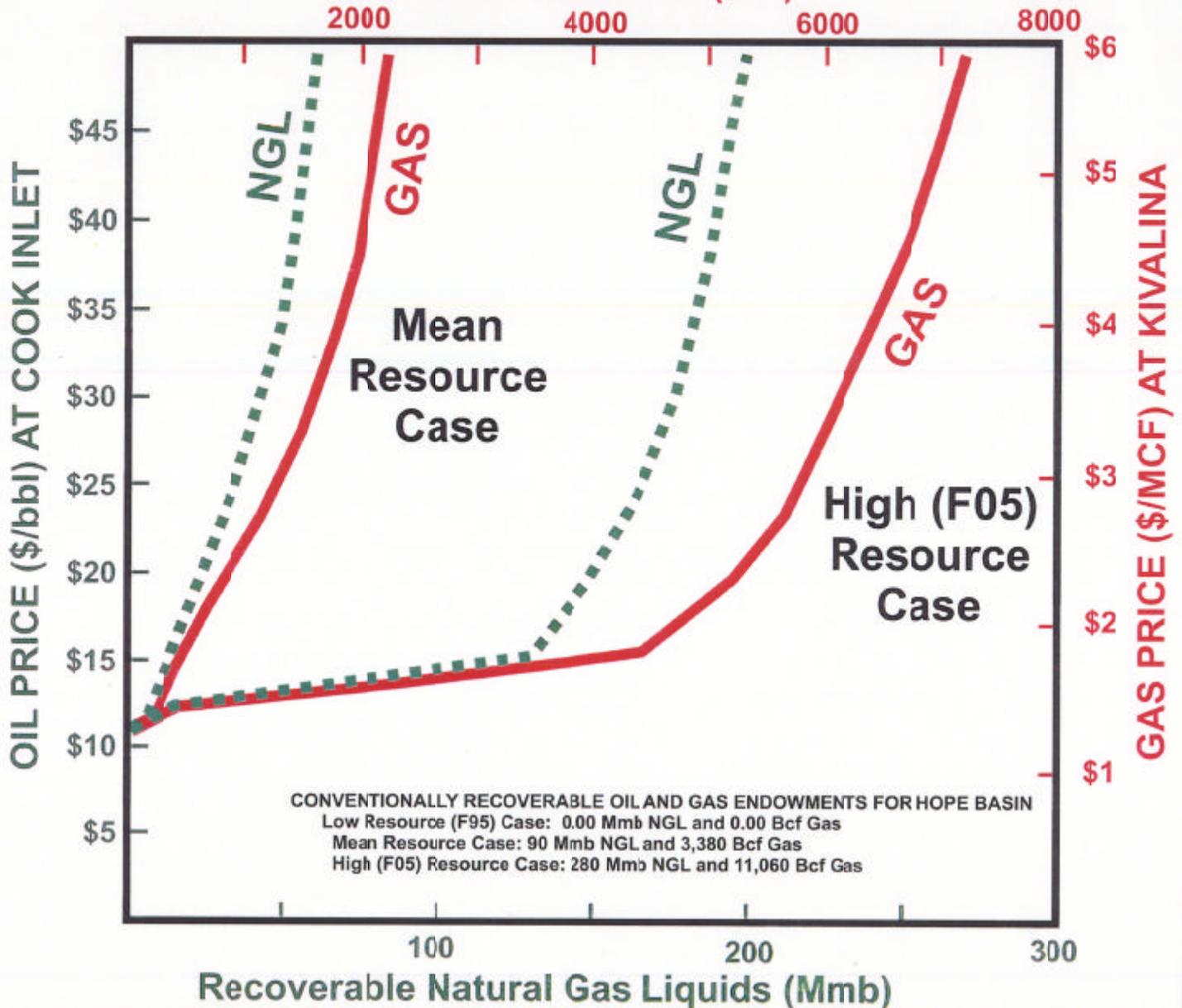
(Gas is Not Taken to Market in Near Term)



# HOPE BASIN PLANNING AREA

ECONOMICALLY RECOVERABLE GAS AND NGL

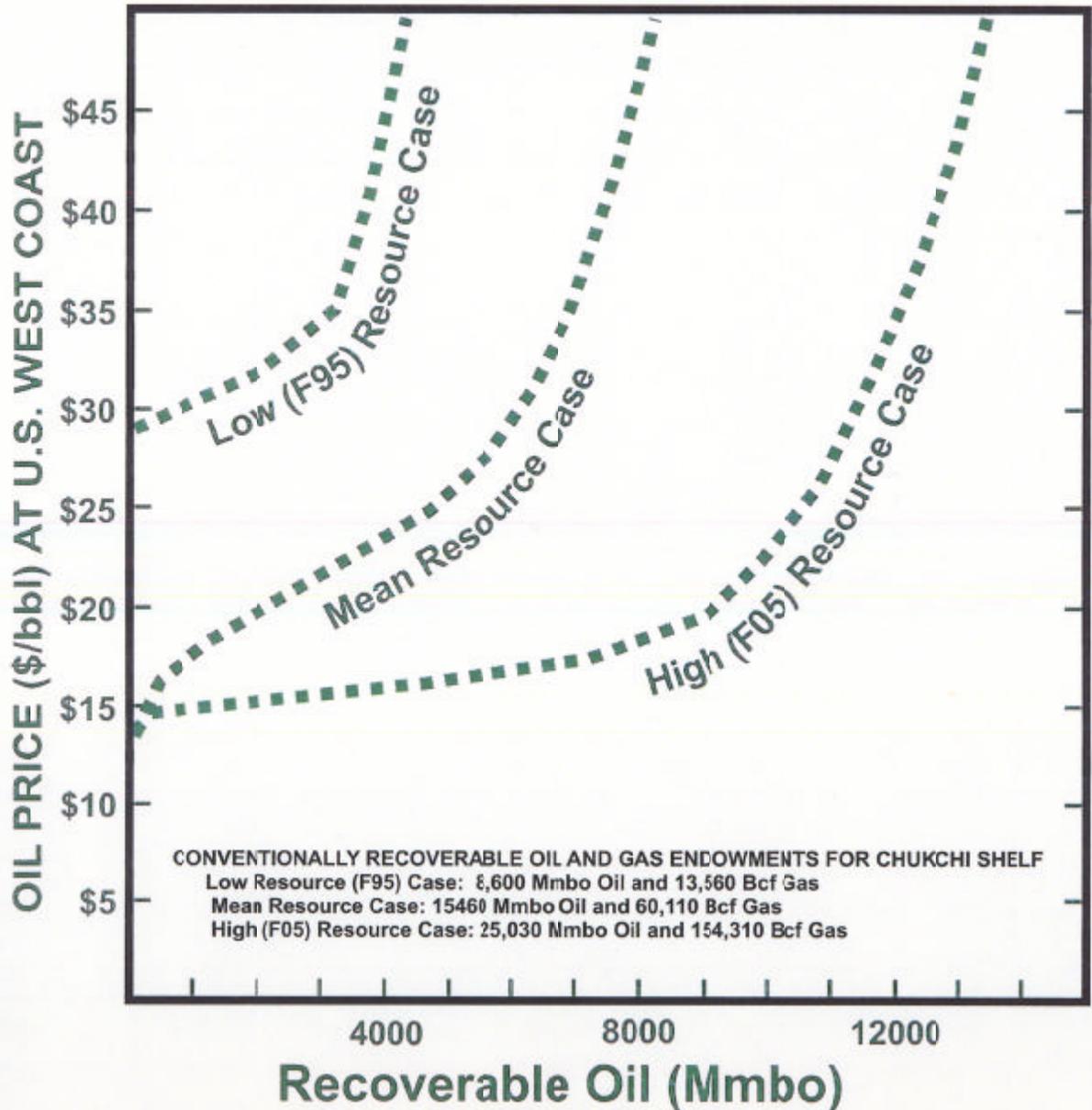
Recoverable Gas (Bcf)



# CHUKCHI SEA PLANNING AREA

## ECONOMICALLY RECOVERABLE OIL

(Gas is Not Taken to Market in Near Term)



# Undiscovered Gas Pools for Hope Basin Planning Area (Non-Associated and Gas Cap)

