

MMS

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

Exploring the Frontier— Alaska's Norton Sound

Geographic and Environmental Setting

The Norton Basin is located off the coast of west-central Alaska, approximately coincident with Norton Sound in the northern Bering Sea. Norton Sound is bounded by the Seward Peninsula on the north, and the Yukon Delta and St. Lawrence Island on the south. The United States – Russia Convention Line of 1867 defines the western boundary of the Norton Program Area. The basin is approximately 125 miles long and ranges from 30 to 60 miles in width.

In the northern Bering Sea, the sea ice is primarily first-year ice. Fast ice forms along the shorelines of Norton Sound and St. Lawrence Island. Pack ice also forms, mostly in situ, and consists of floes that usually are transported southward. By the end of November, most of Norton Sound is usually covered by sea ice. The edge of the pack ice normally occurs south of the program area from sometime in December through mid-April. In a typical year, the sea ice will be gone by mid-July.

The largest community in the area is Nome with a population of about 3,600 people in the city, out of 9,300 in the area. Nome is identified as the probable shore base for oil and gas activities related to the OCS sale. A number of small villages (populations of less than 900) reside on the coast of Norton Sound, such as Emmonak, Unalakleet,

Teller, Savoonga, and St. Michael. Many of these communities are looking for ways to develop their economies.

Exploration History

Two Continental Offshore Stratigraphic Test wells were drilled prior to OCS leasing – COST #1 well in 1980 and COST #2 well in 1982. Twenty-one oil companies participated in financing these wells. Over the course of ten years, different companies collected almost 50,000 line miles of CDP seismic data in Norton Basin. Varying amounts of high-resolution seismic data and gravity/magnetic data have also been collected in Norton Sound federal waters.

In March of 1983, OCS Sale 57 was held in Norton Basin. Most tracts offered for lease in Sale 57 were located east of 166°W longitude. Fifty-nine leases containing almost 336,000 acres were awarded for total high bids of \$325 million. In the summers of 1984 and 1985, six exploration wells were drilled - one by ARCO and five by Exxon. No discoveries were announced. The wells were plugged and abandoned. A second sale, Sale 100, was planned, but never held. The second sale would have offered most of the western portion of the basin for lease. Therefore, a large part of the basin has never been available for testing.

Basin Description

Norton Basin is an extensional basin associated with strike-slip movement along the Kaltag Fault. The formation of Norton Basin probably began during Late Cretaceous time when the Kaltag Fault formed. In the latest Cretaceous and early Paleogene time, strike-slip faulting and regional extension produced major subsidence by block faulting in Norton Basin. Two subbasins formed during the period of fault-controlled subsidence - the St. Lawrence (or western) subbasin and the Stuart (or eastern) subbasin - which are separated by the Yukon Horst. Both subbasins initially filled with non-marine clastics, mainly alluvial fan and delta plain deposits.

The two subbasins existed as discrete depocenters from Paleocene to middle Oligocene time. The Yukon Horst blocked westerly marine invasion into the eastern subbasin during this time. Fault-controlled subsidence ceased by mid-Oligocene time, and subsequent subsidence was regional. From the late Oligocene to the present, a shelf environment, much like that of the present-day, characterized deposition across the entire Norton Basin.

In the Stuart subbasin, sediment thickness ranges up to 23,000 feet of mostly Tertiary clastic sediments deposited in continental to transitional environments – alluvial fans, delta plain, and marginal marine. The St. Lawrence subbasin is filled with up to 15,500 feet of Tertiary-aged sediments. The oldest strata and the basin fill along the basin edges are mostly continental in origin. Depositional environments range from marginal marine to upper bathyal in the rest of the St. Lawrence subbasin fill.

The two COST wells and the six exploration wells encountered good quality reservoir rock in both marine and non-marine sediments. The non-marine rocks contain abundant coal. The COST wells

encountered possible gas-prone source rocks in both of the subbasins. The top of the oil window is approximately 10,000 feet in depth. Based on drilling history, the low amounts of type III kerogen in well samples, and the lack of any significant hydrocarbon shows, Norton Basin is assessed as a gas-prone basin.

Another possible source for hydrocarbons is the basement Paleozoic carbonates and shales that yielded minor amounts of high-sulfur oil in one of the exploratory wells. Virtually no data exist for assessment of the petroleum-generation potential of the basement rocks, however. A CO₂ gas seep occurs on the northeastern edge of the western subbasin, near the location of ARCO's Y-0436 #1 well. The CO₂ gas may be produced by the decarbonization of carbonates in the basement rocks.

Seismic mapping in Norton Basin identified almost two hundred structural prospects, the largest being about 186,000 acres in size. The mapped, potential traps are anticlines, faulted anticlines, and fault blocks. Stratigraphic traps occur along the basin margins and the flanks of the Yukon Horst.

Assessment Results

An assessment of the Norton Basin planning area in year 2000 estimated that conventionally recoverable resources could range from a mean of 2.71 trillion cubic feet of gas upwards to 8.74 trillion cubic feet of gas (at the 5 percent level). Liquid hydrocarbons (modeled as all gas condensates) range from a mean of 0.05 billion barrels of oil upwards to 0.15 billion barrels of oil (at the 5 percent level). The Norton Basin resource model estimates eighty gas pools, with a few showing potential gas resources above 500 billion cubic feet. The development model for Norton Basin proposes producing natural gas for a local market based in Nome with a

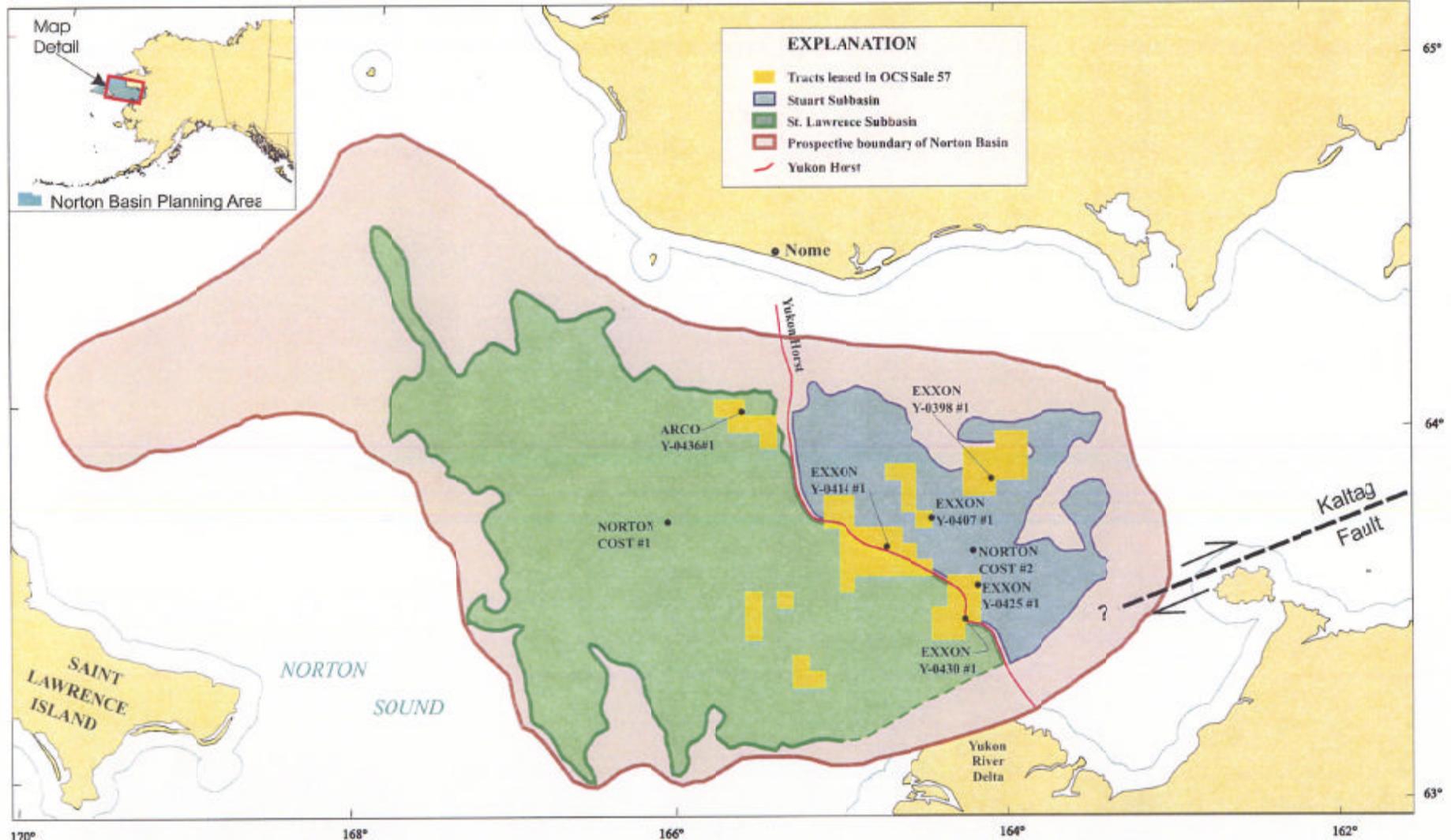
variety of end-uses, such as electrical power generation, industrial fuel, and conversion into fuel products by gas-to-liquids (GTL) technology. The price-supply graph summarizes the results of economic modeling for a Nome-area market. At the mean, one trillion cubic feet (risked) of gas may be economically recoverable at

\$2.11/mcf and 1.6 trillion cubic feet (risked) of gas may be economically recoverable at \$3.52/mcf. High side gas potential ranges from 5.0 to 6.4 trillion cubic feet (5 percent level, \$2.11/mcf to \$3.52/mcf).

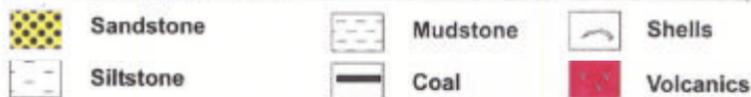
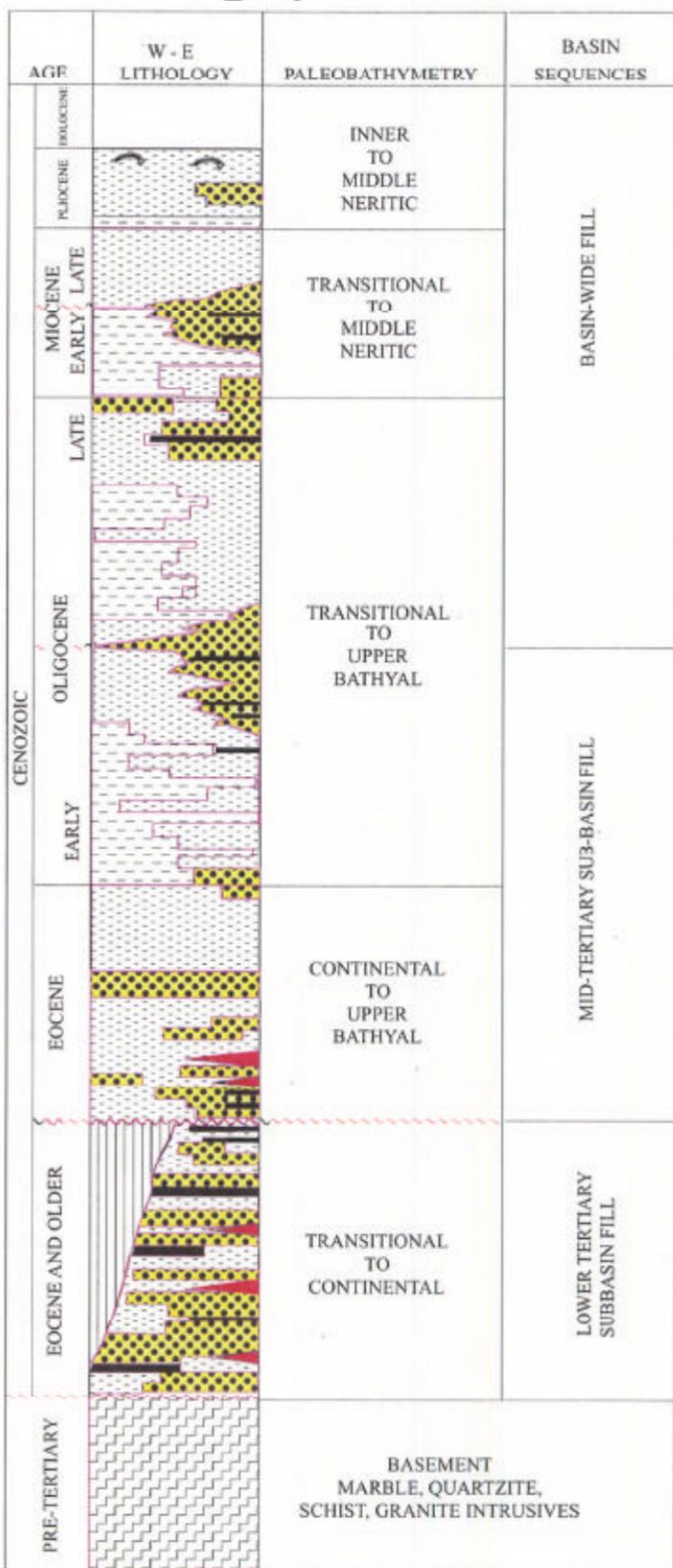
NORTON BASIN
RISKED, UNDISCOVERED OIL AND GAS
(Delivered to Local Market)

RESOURCE CATEGORY	OIL AND NGL (Bbo)			GAS (Tcfg)		
	F ₉₅	MEAN	F ₀₅	F ₉₅	MEAN	F ₀₅
CONVENTIONALLY RECOVERABLE	0.00	0.05	0.15	0.00	2.71	8.74
ECONOMICALLY RECOVERABLE AT \$18/BBL OIL PRICE (and \$2.11/mcf GAS PRICE)	0.00	0.02	0.09	0.00	1.04	5.04
ECONOMICALLY RECOVERABLE AT \$30/BBL OIL PRICE (and \$3.52/mcf GAS PRICE)	0.00	0.03	0.12	0.00	1.59	6.42

NORTON SOUND SEDIMENTARY BASIN

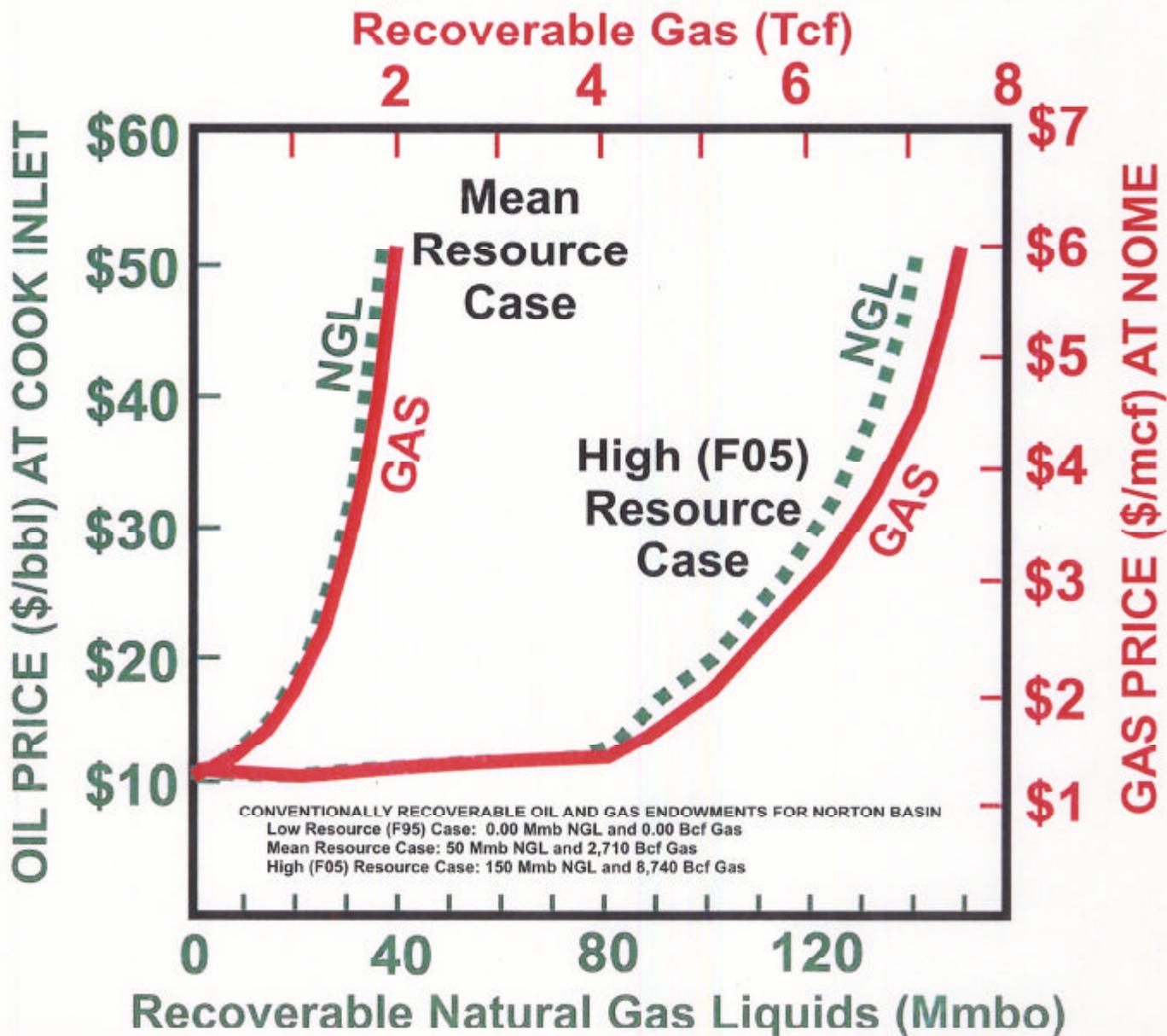


NORTON BASIN Stratigraphic Column



NORTON BASIN PLANNING AREA

Economically Recoverable Gas and NGL



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

