

America's Last Frontier

Having produced over 15 Bbo (2.4 Bm³), Arctic Alaska is one of the most prolific oil producing regions in North America, yet most of the area remains sparsely explored. The huge resource potential is attracting new companies and exploration dollars into frontier areas.

Discovered in 1968, the Prudhoe Bay oil field is the largest in North America.



Photo: Private

"The lead up to the discovery at Prudhoe was sort of interesting. Excitement built and oil shows increased as we drilled through the Cretaceous. The Ivishak reservoir was topped at 8,202 feet (2,500 m) with mud gas readings that went off scale. The drill stem test (DST) that we performed December 27, 1967, was truly exciting and really impressive - immediate strong blow of gas to the surface - which flowed for many hours with a roar and rumble that was like a jet plane overhead," remembers Gil. The experienced geologist, now a consultant, has worked Arctic Alaska for over 40 years. "Future exploration will progressively head west across the Slope and to the Chukchi Sea, chasing mostly stratigraphic traps in the Jurassic and Lower Cretaceous. There will be some pretty significant oil and gas finds," he says.

Gil Mull, pictured in front of Prudhoe Bay #1, was the well-site geologist for the discovery well that found Prudhoe Bay - North America's largest oil field - in December 1967.



Arctic Alaska showing exploration wells and named prospects in the Beaufort and Chukchi Seas.

The supergiant Prudhoe Bay oil field, along with 4 fields discovered the year after Prudhoe, were large enough to prompt development on a massive scale and to build a link to the ice free port at Valdez, Alaska. After 2+ years and \$8 billion, the first oil moved through the 1,200 km pipeline on June 20, 1977.

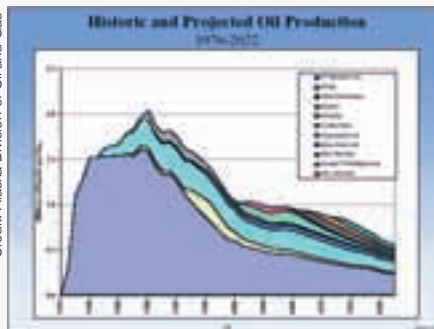


Photo: Tom Smith

Thomas Smith, Associate Editor

In June, Alaska's North Slope has produced oil for 30 years. Now, North America's largest oil field, Prudhoe Bay, is well past its peak. New projects are coming on line near existing production, but none of these are large enough to offset Prudhoe Bay's continued decline. Frontier areas are being actively explored and need to be exploited if the region is to remain a major petroleum producer.

Credit: Alaska Division of Oil and Gas



Alaska's North Slope has produced 15 Bbo (2.3 Bm³), with over 11 Bbo (1.7 Bm³) from the Prudhoe Bay field alone. For about 15 years, the area supplied 25% of the United States' oil production. Currently, discovered reserves of about 7 Bbo (1.1 Bm³) and 35 Tcf (1.0 Bm³) gas remain. Today's production rate is less than 50% of the peak rates obtained in 1988 (2 MMbopd, 0.3 MMm³) and projected production curves show oil production will decline to less than 500,000 bopd (80,000m³) in the next 15 years.

With the increasing availability of pipeline capacity due to reduced production, interest has been stimulated in four areas adjacent to the current development. The Arctic National Wildlife Refuge (ANWR) lies to the east, the National Petroleum Reserve in Alaska (NPRA) to the west, and offshore Beaufort and Chukchi Seas to the north and west.

All these areas are considered to have high resource potential. Many of the key geological elements that contributed to the large accumulations already discovered extend into these frontier areas. Higher oil prices and new technological advances have also made these areas more attractive economically.

ANWR – Endlessly Debated

Many industry and government experts regard the coastal plain of the ANWR as the most prospective unexplored onshore area in North America. Environmental groups, native peoples, and many others, however, regard the Refuge as one of the true remaining wilderness areas in North America and believe oil development would harm the area's unique wilderness, wildlife, and recreational values. Since the inception in 1980, the 6000 km² coastal plain, called the 1002 Area (GEO ExPro, vol.3, no.1, p. 48) has been endlessly debated and is the subject of countless position papers.

NPRA – Ongoing Exploration

In NPRA (formerly Naval Petroleum Reserve No. 4) (GEO ExPro vol. 4, no. 2, p. 70 Hotspot, www.geoexpro.com) two companies have conducted an exploration program this year.

FEX, Talisman Energy's Alaska subsidiary, is actively exploring some of the almost 1.5 million acres (6000 km²) they have under lease. In mid-February, they started drilling two deep wells and if the drilling goes as planned, a third well may be drilled this season. Their previous goal of five wells was only possible if the company had been able to secure tundra access earlier in the winter drilling season, so they staged their exploration from a temporary support base located closer to the wellsites.

ConocoPhillips is the other company drilling NPRA this winter as part of their 5-year exploration plan for the area. Up to five wells were planned, however, because of a late start in drilling, only two wells will get drilled this season.

Another interesting development is that a new company was formed, **Renaissance Alaska**, to drill an appraisal well in the old Umiat field in 2007-08. The field was discovered in 1946 with 11 wells drilled by the U. S. Navy. The reservoir is shallow with a portion of the oil in permafrost. Recovering the estimated 100 MMbo (16 MMm³) could be challenging. ▶



Photo: Tom Smith



Companies are looking to new drilling targets in NPRA like the sandstones and conglomerates of the Lower Cretaceous Fortress Mountain Formation.

OCS – Promising Discoveries

The Minerals Management Service (MMS) has held nine lease sales in the Beaufort Sea since 1979. Thirty-one wells have been drilled on the acreage between 1981 and 2002 with eight determined producible under MMS regulations.

The **North Star field**, with both State and Federal acreage, is the only producing field in the Beaufort OCS area. Liberty will soon go into production using extended reach drilling. Shell discovered and is operating both fields.

Beaufort Sea Sale 202 was scheduled for April 2007 and will be the last sale in the current 5-year program. The previous sale was held March 30, 2005 (Sale 195) where 117 leases were issued.

After an 8-year absence, **Shell** was back in a big way winning 105 leases in the Beaufort Sale, and an aggressive exploration program is planned for 2007. Prior to leaving the State in 1998, Shell explored both the Beaufort and Chukchi Seas having participated in most of the 31 wells drilled in the Beaufort and 4 drilled in the Chukchi. New drilling and production technologies and higher oil prices have attracted them back.

Shell is currently looking to find new prospects and preparing for future lease

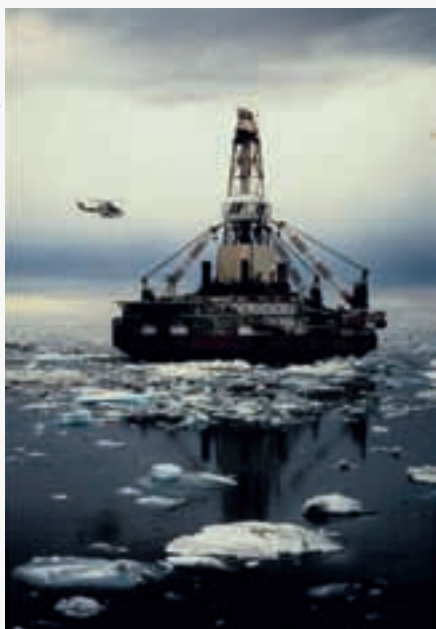
Huge Resources

The United States Geological Survey periodically conducts resource assessments of undiscovered oil and gas resources (GEO ExPro 2007, Q & A, v. 4, no. 2 p. 68). The most recent estimates of the total mean volume of undiscovered resources in the Arctic Alaska Petroleum Province are more than 50 Bbo (8.0 Bm³) and 227 Tcf (6.4 Bm³) gas, distributed approximately equally between Federal offshore and combined onshore and State offshore areas. None of the figures, however, take into account unconventional resources like coalbed gas, gas hydrates and gas from tight formations. These unconventional resources could be huge as there is over 4 trillion tons of coal currently mapped on the North Slope.



The Brooks Range fold and thrust belt offer exploration opportunities for both structural and stratigraphic traps in Jurassic and Cretaceous rocks. The area has been sparsely drilled.

Photo: Randy Howell, MMS



Shell's drilling program in the Beaufort Sea will feature the Kulluk rig and another specially outfitted drill ship.

Photo: AOGA



Judy Brady of the Alaska Oil and Gas Association has registered new interest in exploring frontier areas in Alaska because of a combination of new technologies, new data and higher oil prices.

sales as it has applied for three 3D seismic programs, one of these is located in the Chukchi Sea. In 2006, Shell was able to acquire data in the Chukchi but ice conditions kept them out of the Beaufort Sea. The summer 2007 drilling plans include 3 wells at the Sivulliq prospect. **Union** explored this prospect in 1985 and 1986 at what was then called Hammerhead. Minerals Management Service (MMS) estimates

North Slope - North Sea Compared

In the 1960's, Alaska's North Slope (ANS) and the United Kingdom's North Sea were frontier areas about the same size aerially. Large discoveries in the North Sea that were developed in the 1970's pushed up production rates that remained similar into the early 80's. After that, the UK North Sea production has exceeded that of the ANS. Other differences include 1) ANS production is predominately onshore, while UK North Sea is entirely offshore; 2) in 2003, the UK North Sea had 29 operators, while the ANS was down to just four; and 3) the UK North Sea has production from 179 oil fields and 108 gas fields, while ANS has production from 28 oil pools and no gas market.

Jack Walker of ConocoPhillips and others in their 2006 SPE paper "UK North Sea and Alaska North Slope: A Comparative Analysis of Petroleum Provinces" conclude that three major factors have led to the production differences of these two very similar provinces.

First is the presence of a gas market. Gas production actually preceded oil production in the UK North Sea. In barrels equivalent, the North Sea has produced more than double that of the ANS, with gas production accounting for about one-third of the overall production.

The second and third factors concern governmental regulations. The UK North Sea has been more accessible and simpler in resource ownership and government take than ANS.

This gas market factor could be changing for ANS, as four major companies and the State are all pushing for a gas pipeline to bring North Slope gas to US markets. The State has recently committed \$500 million to the proposed project and has introduced a bill that would reward producers making commitments to ship gas and would simplify royalty rates. The goal is to start fieldwork in 2008, but many regulatory and contract hurdles still stand in the way of this huge project.

Outside the central North Slope coastal area, ANS is sparsely explored. The UK North Sea is now considered a mature petroleum province. Government incentives have, however, resulted in recent increases in exploration activity and a large number of new companies operating in the area (GEOExPro 2006, vol. 3 no. 6, pp. 44-46). Area wide leasing of the ANS, and recent changes in the royalty and tax structure on both State and Federal lands, is making acreage more available than ever. Exploration into Alaska's frontier areas has accelerated in recent years. Still, companies complain that improvements through land access, permitting efficiency, and tax regime are needed to keep a viable Alaska petroleum industry.

100 to 200 MMbo (16-32 MMm³) could be recoverable, however, the previous 2 wells did not fully evaluate the prospect. Shell plans to drill several wells each season through 2009.

Chukchi Sea Lease Sale 193 is now scheduled for February 2008. Two previous area wide lease sales took place in 1988 and 1991 with 5 wells drilled on these leases. 3 wells, possibly all 5, found pooled hydrocarbons, the largest being a gas discovery by Shell at the Burger prospect. Exploration is going ahead with TGS-NOPEC applying for a 2D program in the Chukchi and Shell's 3D program is planned for 2007. Three 3D seismic programs and one 2D seismic program were shot in 2006.

"We received broader industry interest in the Chukchi Sea planning area than expected," said John Goll, MMS Alaska Regional Director, "so we will proceed with

the process to evaluate holding a conventional area wide sale."

Judy Brady of the Alaska Oil and Gas Association sums up success for Arctic Alaska this way: "From the 1950's to today the vast majority of the oil and gas discoveries in Alaska have been on State-owned land, either in Cook Inlet or the world class fields on the North Slope. This means the State controls the "door" to these resources through their leasing, permitting, and fiscal policies."

"Annual, area wide sales have been the most successful State policy. The area wide strategy, along with new technologies, new data and higher oil prices has brought renewed interest to frontier areas," she concludes.