



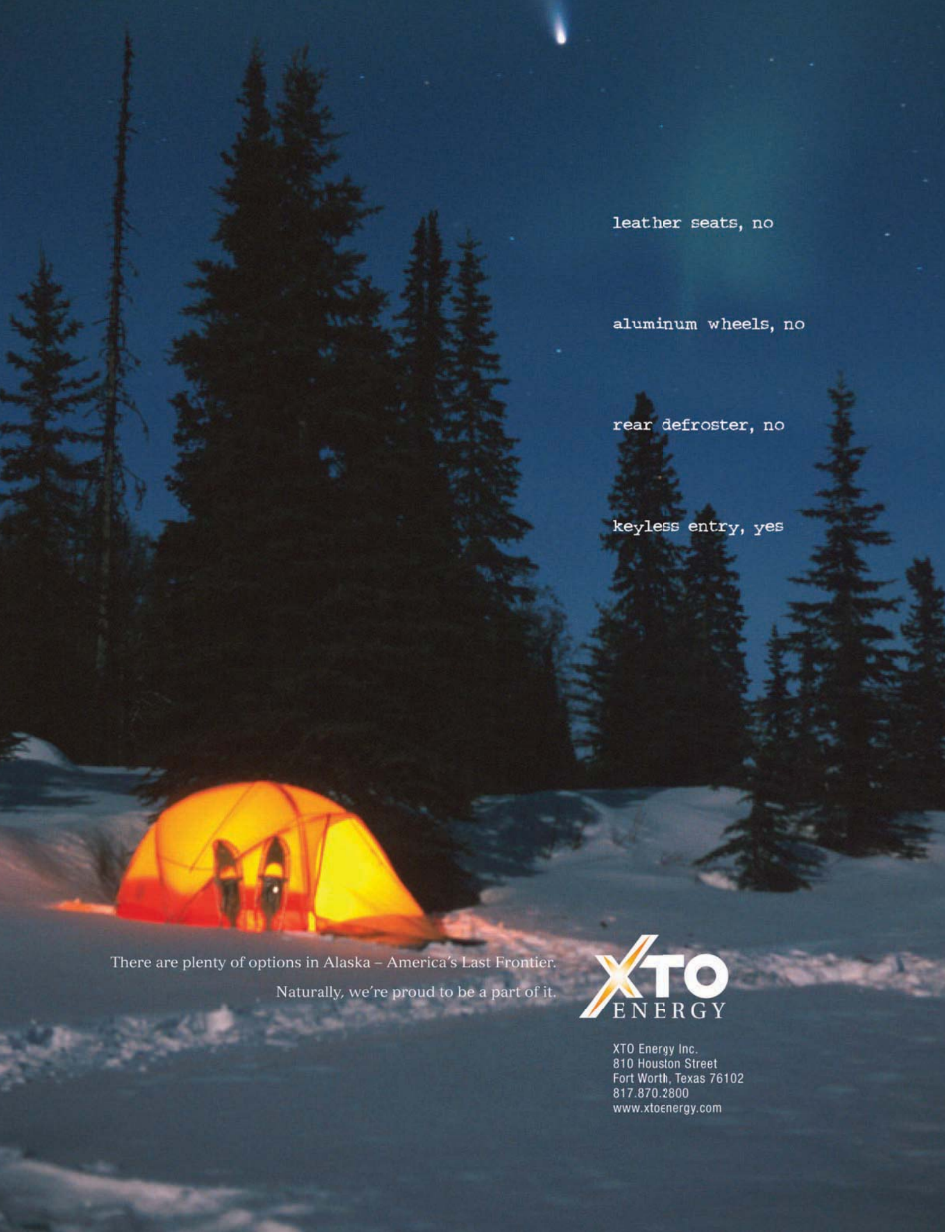
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The Explorers, an annual publication  
from Petroleum News



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# What's cooking in the Cook Inlet

*New players are setting their sights on the Cook Inlet basin*

By KEVIN BANKS

Director, Division of Oil & Gas, Alaska  
Department of Natural Resources

Interest in natural gas exploration, production and storage in Alaska's Cook Inlet is growing, thanks to efforts by the state to encourage exploration and drilling while remaining sensitive to the needs of industry to be able to respond to fluctuating energy demand in this still very vibrant resource area.

Over the past year and a half, the Division of Oil and Gas met with several companies interested in Alaska. The news last month that Chevron, a company that has been in Alaska since before Statehood, was looking to sell their Cook Inlet assets does not detract from our optimistic view of the future of the area. Chevron has been a good partner for the state for many years. Now, we are welcoming the entry of new, smaller companies with a more targeted focus on exploration and production in Cook Inlet, knowing that they will have opportunities to develop resources, provide jobs to Alaskans and make a good profit at the same time. Keep in mind that "smaller" doesn't necessarily mean little: there's interest in the Cook Inlet expressed by companies that have billions of dollars of assets and are perfectly capable of expanding exploration and production activities in the rich, under-explored Cook Inlet basin.

Together, the state and industry have shown detractors that Alaska remains open for business, and the ill-informed statement that "Southcentral Alaska is facing an inevitable shortage of natural gas" will be proven wrong.

Cook Inlet currently provides one of the most favorable tax and



KEVIN BANKS

royalty environments in the world and there is every reason to believe we can meet the energy needs of the region. Last year the Division published the "Preliminary Engineering and Geological Evaluation of Remaining Cook Inlet Gas Reserves" that conservatively predicted that substantial gas reserves could still be developed within the existing fields of the Cook Inlet. This fall we've launched a follow-up study to gain a better understanding of the costs of developing these new reserves. We hope to have this second report published by the end of the year. Initial results indicate that the news should be encouraging for residents and industry alike.

In its last session, the Alaska Legislature passed a bill offering up to \$25 million in tax credits for exploration expenses associated with the first well drilled from a jack-up rig. For operators who aren't planning for offshore exploration or don't meet the criteria for receiving the jack-up rig credit, there are other credits available — both in Cook Inlet and everywhere else in Alaska — of between 20 and 65 percent for all capital expenditures related to oil or gas exploration or development.

The Legislature also expanded the existing gas development tax credit, from 10 percent to 25 percent of costs of drilling and field development work in existing gas fields.

The state even offers special credits for "small" producers whose annual production is less than 50,000 barrels of oil equivalent.

In the past, the question of whether there was enough of a market to support increased development in the Cook Inlet kept exploration companies lukewarm about the prospects. But with changing times, the market is also changing. Anchorage, the state's largest city and home to almost half of the state's population, almost completely depends on Cook Inlet gas for home heating and

see BANKS page 14

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**MAILING ADDRESS:**

PO Box 231647

Anchorage, AK 99523-1647

Phone: (907) 522-9469

Fax: (907) 522-9583

Email:

circulation@PetroleumNews.com

Web page:

www.PetroleumNews.com

*To order additional copies of this special publication, contact Clint Lasley, Petroleum News general manager and circulation director, at [clasley@petroleumnews.com](mailto:clasley@petroleumnews.com)*

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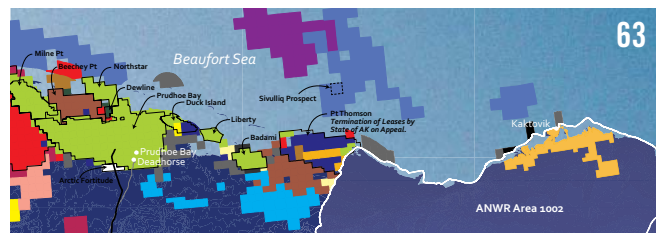
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MARTI REEVE  
SPECIAL PUBLICATIONS DIRECTOR

ALAN BAILEY  
SENIOR STAFF WRITER

ERIC LIDJI  
CONTRIBUTING WRITER

STEVEN MERRITT  
PRODUCTION DIRECTOR

MAPMAKERS ALASKA  
CARTOGRAPHY

KAY CASHMAN  
PUBLISHER & EXECUTIVE EDITOR

MARY MACK  
CHIEF FINANCIAL OFFICER

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*Paul Decker and Paul Anderson of the Alaska Department of Natural Resources, Division of Oil and Gas, contributed to the content of The Explorers.*

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# The need to drill to pay the bill

By TOM MALONEY

Alaska Area Manager, CH2M Hill, and Board President,  
Resource Development Council for Alaska

Alaska has been a great domestic oil source, including 33 years from Prudhoe Bay made possible by the trans-Alaska pipeline system. This production has benefited the State of Alaska by approximately \$96 billion through 2009.

How are current production levels? What will the next decade bring? Will TAPS have enough oil to continue running? Will our kids and grandkids have a future in Alaska? Will state and federal governments take positive action, in time? What can we do to get our economy moving again? These are just a few questions that our leaders need to address. The clock is ticking. We all need to acknowledge the risk to our economy from declining oil production.

Cook Inlet oil production declined 95 percent from its 1970 peak of 230,000 barrels per day to 12,000 bpd in 2010. Meanwhile, production from state lands across the prolific North Slope has declined to under 650,000 bpd, down 70 percent from a 1988 peak of more than two million bpd.

Wayne Gretzky, The Great One, said, "You miss 100 percent of the shots that you don't take." The same is true with hydrocarbons.



TOM MALONEY

Without drilling, you get no new production. Without new production, the only question is when will the oil run out?

Industry recognizes production is drying up. However, many Alaskans don't know TAPS has declined 70 percent over 20 years. Oil represents one-third of Alaska's economic drivers.

## What can we do?


Tax policy must change in a way that reflects the important role drilling has in Alaska's economy. Investors take 100 percent of the risk to lease, explore and develop a resource. At high prices, government can take more than 90 percent of the income stream of a barrel of oil. What is the incentive for an investor to take risk? Would anyone with their real estate, stock, or other investments give the government all the upside while taking nearly all the downside?

In 2007, Alaska had 188 wells drilled, including 22 exploration wells. The 2010 forecast calls for 150 wells and only five exploratory wells. We need to encourage industry and government dialogue to reverse this steep decline.


Drilling credits are a fast way to stimulate investment, leading to a positive economic impact and employment opportunity for Alaskans. Drilling benefits multiple employment sectors, including those captured in the diagram featured in this commentary.


Gov. Sean Parnell proposed drilling credit legislation last year.

see MALONEY page 13



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# Welcome to 'The Explorers' 2010

**W**elcome to The Explorers, an annual magazine from Petroleum News that is released each November at the Resource Development Council for Alaska's conference in Anchorage.

The Explorers was first published in 2002 as The Independents magazine, but in 2004 we changed the name to The Explorers because, among other things, we wanted to salute companies that were actively searching for hydrocarbons that would help secure Alaska's economic future.

And although not much exploration is planned for this coming year, development drilling continues in the northern part of the state and the chance to finally drill some promising offshore prospects in the Cook Inlet basin looks possible with assistance the State of Alaska is offering the first three companies to bring a jack-up rig to Alaska.



MARTI REEVE

In the near future, it appears there will finally be pipelines to the Eastern North Slope, opening that region to exploration and development. As I write this editorial in mid-October 2010, BP, with the assistance of independent Savant Alaska, is in the process of permanently re-opening the Badami unit and pipeline, 20 miles east of Endicott, where the operational North Slope pipeline currently ends. And ExxonMobil is planning to take pipeline development 22 miles further east with a liquids line from the Point Thomson field in 2014.

So, this magazine is about Alaska's oil and gas explorers and developers — independents and majors.

We hope you find it of interest.

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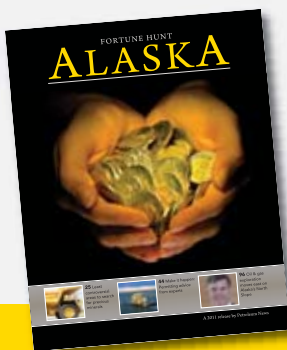
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Best wishes in 2011,

—Marti Reeve, special publications director  
Petroleum News

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# Alaska: A brave new world for explorers, producers

*A review of federal policy assaults on Alaska's economy and ramifications for oil and gas exploration and production*

By DAVE HARBOUR

Shakespeare coined a phrase for Miranda in Act V of "The Tempest," when he wrote of a brave new world filled with good people. By Aldus Huxley's time other authors had used the term—mostly in positive ways. But Huxley's 1931 parody of an H. G. Wells utopian novel painted a world where leaders regulate (limit) the world's population and fetuses are cultured in decanters and conformed by chemical persuasion into desired "classes."

When Huxley wrote "Brave New World," his futuristic novel set in 2540, he had no idea how quickly world evolution could occur; he had no concept of the exponential leapfrogging of social, political and scientific paradigms that modern jet planes, computers, the human genome project and the Internet would enable.

Alaskans are witnessing a brave new world evolve before their eyes. It is a world wherein the trend toward greater federal con-



DAVE HARBOUR

trol of Alaska — aided and abetted by environmental activism — has quickly morphed into a full-fledged, tsunami-like paradigm shift affecting Alaska's economic future. Economist David Reaume wrote in the Anchorage Daily News in October: "One would think that Alaska's low rate of growth of inflation-adjusted GDP would produce a startling high and rising unemployment rate and, in truth, it has risen dramatically in 2009 and 2010."

Seeing evidence of this paradigm shift a year ago, I editorialized in Northern Gas Pipelines about the volume of federal government attacks on Alaska's wellbeing. I suggested that the cumulative weight and frequency of these attacks had the effect of imposing on Alaska's economy, a "death by a thousand cuts." Since then, federal attacks have intensified, leading to a more rapid destruction of Alaska's economic potential. Alaska Support Industry Alliance President Joe Hegna observed this fall that, "Our oil and gas industry has lost 1,700 jobs in less than three years. Unemployment claims have doubled. Drilling — development and exploratory — is at its lowest level in at least 10 years. Billions of dollars in investments have been lost or deferred."

While state tax, leasing and regulatory policies have an undeniable impact on Alaska's investment climate, here we will review the effect of a hostile federal regime on Alaska's economic health. As we absorb these federal initiatives — none of which supports reasonable economic growth — we should keep in mind that the interests of Alaska's explorers and producers are pretty well aligned with Alaskan parents. After all, parents want a good future for their kids and themselves. At Alaska's Sixth Annual Oil and Gas Congress in September, former Alaska Gas Pipeline Federal Coordinator, Drue Pearce, testified, "... the Obama Administration is ... engaged in a very effective agenda of shutting down Alaska's oil and gas industry."

Here are a few federal actions occurring since Barack Obama became president, none of which benefit and all of which endanger Alaska's economic health:

- April 2009. Department of Interior Secretary Ken Salazar visited Anchorage and other cities to conduct hearings on the Minerals Management Service (MMS, now BOEM) five-year leasing programs. The 2007-12 and 2012-17 programs have presented no new opportunities for exploration, only orders from the Secretary to cancel programs, conduct more studies and deny access by rejecting permit applications.

- June 2009. Sen. Mark Begich proposed to establish a Federal Arctic Regional Coastal Advisory Council that could tax the industry for its expenses and require industry to participate in its proceedings with no vote, "in good faith." The presumption is that coastal voices need greater amplification, even though their legal alliances with environmental groups have resulted in delayed exploration affecting all Alaskans. (July 2010. Governor op-

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poses ARCAC)

- August 2009. A White House Ocean Policy Task Force created by President Obama via executive order held a hearing in Anchorage. The order specified that within six to nine months the Task Force would provide recommendations which he subsequently adopted. This effort claims to not, "require new legislation to be implemented," but actually, "directs Federal agencies to implement" Task Force recommendations under the guidance of the National Ocean Council, a not very subtle way to avoid Congressional scrutiny and usurp the constitutional rights of states. If anything, this initiative will delay or stop resource exploration and development of all kinds in many OCS and coastal areas.

- September 2009. The Environmental Protection Agency (EPA) visited Alaska to hear testimony on whether it should grant a Clean Air Act permit to Shell Oil. EPA's reluctance to approve Shell's reasonable applications for permits to explore the Chukchi and Beaufort seas on leases it purchased from the federal government in good faith has resulted in continual, unjustified rejections and delays in Shell's exploration programs.

- March 2010. Gov. Sean Parnell urged the U.S. Army Corps of Engineers to withdraw its denial of ConocoPhillips Alaska's permit application to construct a drill pad on its CD-5 Alpine Satellite Development within the National Petroleum Reserve-Alaska. One wonders where oil can be developed in America if not on leases acquired from the federal government in good faith within a national petroleum reserve!

- July 2010. The Parnell Administration vowed to fight "...Improper listings and critical habitat designations with sound science and cost data," referring to efforts by the U.S. Fish and Wildlife Service (USFWS) to designate 187,166 square miles as a critical habitat for polar bears — an action Alaska and the Arctic Slope Regional Corp. believe will cost Alaskans hundreds of millions of dollars in economic potential.

- September 2010. The State of Alaska sued the Secretary of the Interior in U.S. District Court to overturn the federal moratorium on offshore drilling in Alaska's OCS, on grounds that the Obama administration violated federal law and acted in an arbitrary and capricious manner.

- September 2010. Alaska challenged National Park Service reg-

ulations, claiming they violate federal law, usurp state sovereignty, and infringe the liberty of Alaskans.

- September 2010. Alaska objected to USFWS steps to seek wilderness designations for the 1002 area within the Arctic National Wildlife Refuge's 19 million acres that would prevent development of up to 16 billion barrels of oil.

- September 2010. The State of Alaska petitioned the National Marine Fisheries Service (NMFS) to remove the eastern distinct population segment (DPS) of Steller sea lions from the list of species protected by the Endangered Species Act (ESA).

On Jan. 20, 2010, in his State of the State Address, Parnell discussed Alaska Statehood Act history, recalling that, "With statehood, the strong assumption prevailed that, as a fledgling state, we would be allowed to develop our own resources without constant federal interference." He said the federal government, "misused the Endangered Species Act...proposed setting aside an area larger than the state of California as critical habitat for polar bears...hyperextends its reach by proposing to zone the oceans..."

After the Prudhoe Bay discovery in 1968, followed by passage of the 1971 Alaska Native Claims Settlement Act and subsequent construction of the trans-Alaska oil pipeline, Alaska's brave new world was a challenge of plenty, how to wisely deal with wealth.

The pipeline is two-thirds empty today and its throughput declines by about 6 percent a year. The state's entire economy is now one-third dependent on oil traversing the pipeline and the state government's general fund is about nine-tenths dependent on that black oil income stream.

Since the majority of Alaska's 570,000 square miles is controlled by the federal government, support for economic development by the feds is critical to pipeline throughput. To remain in operation for more than another 10 to 30 years, the pipeline needs throughput from the Beaufort and-or Chukchi seas, the National Petroleum Reserve Alaska and-or the Arctic National Wildlife Refuge—all controlled by the feds.

The citizens of Alaska — and their elected leaders — must cooperate with Alaska's exploring and producing investors as never before if they are to jointly overcome the challenge of today's

see HARBOUR page 14

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MALONEY *continued from page 8*

Legislators did not vote on this 2010 proposal.

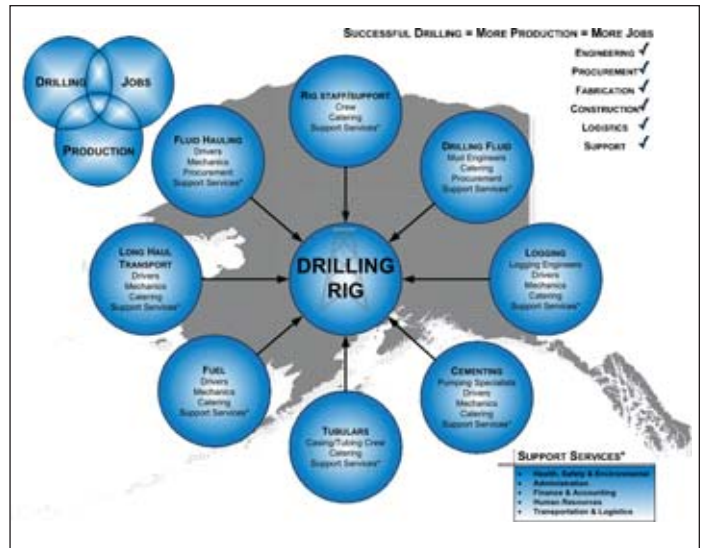
Challenged (heavy) oil is abundant, with more than 20 billion barrels of reserves. Recovery rates are currently low and production costs are high. Research, combined with better tax policy, is needed to increase challenged oil investment. While the existing fields are in a fairly predictable state of decline, challenged oil presents an opportunity for incremental production to increase flow in TAPS.

The gas pipeline has been a long-time dream. Opportunities stemming from a positive Open Season would accelerate gas and oil developments. In other words, "drill baby, drill." The outcome may surprise you. We should consider tax changes for shippers willing to commit resources to a gas pipeline. Introducing tax incentives in exchange for pipeline progress commitment, including development costs, would curb investor concerns.

These ideas should help in the short run. We need positive change in 2011, or we may not have a long-term future as an oil and gas state. We need to encourage production. One hundred percent of nothing is still nothing.

### The feds and North Slope development

The U.S. Geological Survey, funded by taxpayer dollars, estimates reserves on federal lands. The three largest potential reserves on the North Slope are nine billion barrels in the National Petroleum Reserve-Alaska, 27 billion in the Outer Continental Shelf in the Chukchi and Beaufort seas, and 10 billion in ANWR. At current prices, this would be worth roughly \$3.7 TRILLION, excluding gas sales.



The North Slope to date has surpassed 16 billion barrels of production. Federal areas in the Arctic have three times the reserves of what has been produced on state lands in the region.

### National Petroleum Reserve-Alaska

From 2000 to 2009, 29 exploratory wells were drilled in NPR-A by five firms that invested billions to lease, explore and drill over the 10-year period. How many barrels of oil have been produced? Zero. Billions of dollars out the door, and nothing in — partly due

see MALONEY page 14

The oil and gas industry of North America remains the premier industrial and technological leader in the world economy. Exploration and development opportunities abound right here inside the world's largest energy market.

Vast areas of state-owned land are available through the Alaska Department of Natural Resources' predictable lease sales and exploration license programs.

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**MALONEY** *continued from page 13*

to multi-year delays in permitting and other regulatory issues.

ConocoPhillips has suspended development plans, not only at CD-5, but at multiple other NPR-A sites. These delays cost Alaskans dearly in high-paying jobs like drilling, engineering, fabrication, installation, etc.

2010 was the first year in decades that ConocoPhillips did not drill any exploratory wells in Alaska. NPR-A will not have any exploratory wells drilled in 2011. When will the federally controlled petroleum reserve finally produce petroleum?

**Outer Continental Shelf**

The abundant oil and gas resources in Alaska's OCS, typically in less than 150 feet of water, attracted \$2.7 billion in lease sales from Shell Exploration & Production and ConocoPhillips in 2008. Federal delays impeded Shell's 2010 plans and cost about 600 jobs. It is estimated oil and gas development will create 35,000 Alaskan jobs. The oil alone, valued at over \$2 trillion, would stimulate federal and state coffers, and keep TAPS operating for decades to come.

**Arctic National Wildlife Refuge**

Polling reveals 78 percent of Alaskans favor developing ANWR's 10 billion barrels. A majority of Americans believe Alaskans oppose opening the 1002 area of ANWR. Let's clear this up, once and for all and put it on a ballot.

Alaska possesses oil on the North Slope and the right to develop it could lead to a positive future. The need for fiscal policy and a streamlined permitting process that supports looking for this challenged and costly oil will greatly influence Alaska's future in oil.

Alaska has the opportunity to stem the rapid decline of North Slope and Cook Inlet production. We must educate Americans that Alaska's natural resources can be responsibly developed. RDC will continue to work with interested parties to ensure we have a bright future by growing Alaska through responsible resource development.

**BANKS** *continued from page 5*

electricity. Utilities are signing up for shorter contracts with their usual suppliers—and offering higher than historical prices—thereby opening up the market for new producers.

The state has also been sensitive to industry's need to better manage seasonal fluctuation in demand for natural gas in the area supplied by Cook Inlet and how those fluctuations have forced producers to adapt their production rate to the rate of demand. Recent legislation established tax credits and expedited the leasing and permitting processes for natural gas storage facilities starting operations between Dec. 31, 2010, and Jan. 1, 2016.

Good rocks, zero production tax on oil, low production tax on gas, attractive tax credits and interest in the basin from new players means that the Cook Inlet is, indeed, cooking.

**HARBOUR** *continued from page 11*

brave new world: the challenge of shortage.

Overcoming the threatening paradigm shift toward vanishing state wealth and increased federal control of Alaska will require a dramatic improvement in federal attitude and policy, and a very inviting Alaska state investment climate. Confronting today's brave new world could also require Alaska's leaders to bravely sue the federal government for violation of the Alaska Statehood Act.

It is bad news that these two years of constant federal policy assault have delayed projects and endangered Alaska's prosperity. The good news is that one or two election cycles could restore exploration and production normalcy within Alaska's federal jurisdictions.

*Dave Harbour is a member of the board of directors of the Alaska Support Industry Alliance and publisher of Northern Gas Pipelines (www.northerngaspipelines.com). A former Chairman of the Alaska Council on Economic Education, the Anchorage Chamber of Commerce and President of the Alaska Press Club, Harbour is a retired member of the Regulatory Commission of Alaska and Commissioner Emeritus of the National Association of Regulatory Utility Commissioners.*



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# Access is key to sustain and grow Alaska's oil and gas industry

By TOM IRWIN

Commissioner, Alaska Department of Natural Resources

For decades the State of Alaska has partnered with the oil and gas industry to develop our abundant oil and gas resources. Throughout this relationship we have worked to address industry's needs while protecting our own. The Department of Natural Resources invites our industry partners to continue to discuss how we can support each other to move forward into the new energy territory that lies ahead.

Access to state land is the lynchpin for addressing all concerns and interactions in the state's ongoing partnership with industry. Access is provided through annual lease sales for areas of land with known petroleum potential. Access is also acquired through exploration licenses in areas outside those leases. Once you establish access through a stable and predictable exploration permitting environment, all other factors relevant to the production of our oil and gas resources can be identified and evaluated through the permitting process.



TOM IRWIN

We know the resources are there. The Circum-arctic Resource Appraisal from the US Geological Surveys estimates 30 billion barrels of oil and 221 trillion cubic feet of gas are present in Arctic Alaska. That makes Arctic Alaska the second largest source of hydrocarbon resources in the Arctic.

State and federal agencies are the gatekeepers to accessing the state's resource-rich land and coastal regions. Having world-class hydrocarbon resources means little if these resources remain in the ground. Leasing these lands but encumbering those leases with conditions that limit exploration activities is bad business. If the industry's annual activities barely extend beyond paying annual rental fees, our businesses, our state, our nation and energy consumers all suffer.

The State of Alaska understands and is willing to share its expertise regarding regulations and operating in Arctic conditions with those federal agencies that are currently hindering exploratory activities in the federal OCS. It is in the state's interest that the federal outer continental shelf (OCS) be developed, because this would encourage development of adjacent state land.

Alaskans care deeply about the environmental impact of resource development in and around our state. These activities take place literally in our back yard, and we monitor them appropriately. We also believe that industry is concerned about the potential for spills. No one wins from an oil spill. The Deepwater Horizon blowout had a devastating impact in the Gulf that continues to resonate in Alaska.

For years our understanding of the challenges to work in the Arctic has grown. Over this time the industry has developed the unique engineering and technological skills to work in this environment. In turn, the state has provided a predictable regulatory environment to allow that work to proceed. The state also monitors industry activities on the North Slope and throughout the state. Through this relationship we all ensure that Alaska's resources are developed safely and responsibly.

The State would like the federal government to credit industry and the state for their expertise for working in an Arctic environment. Little is gained by imposing burdensome limitations and random halts to exploration and production. Due to the Gulf spill, Alaska's shallow Arctic waters were included in the federal moratorium on deep-water drilling, without good reason. When the moratorium was lifted on Oct. 12 for the Gulf of Mexico, it remained in place in Alaska. There is no rational explanation to continue the moratorium in Alaska.

The state continues to improve the way it coordinates with agencies, project applicants and the public to ensure that the permitting process proceeds as efficiently and effectively as possible. We have made great strides in this regard, as evidenced by support from industry members. Representatives for Cook Inlet Natural Gas Storage Alaska (CINGSA) have testified that the state's permitting process has been working quite well. At a House Energy Committee hearing a company representative commented that, "Every-

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see IRWIN page 19

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# New player takes big ANS position

*Texas-based Great Bear Petroleum plans to open Alaska office*

By KRISTEN NELSON  
Petroleum News

Newcomer Great Bear Petroleum LLC made a big showing at the Oct. 27 Alaska North Slope areawide lease sale, taking 105 tracts, more than half a million acres and some \$8 million in apparent high bids.

The total for the sale was 129 tracts sold, 602,880 acres and \$8,811,226.40 in apparent high bids.

NEW PLAYER

Ed Duncan, Great Bear's president and COO, said after the sale that he didn't target 100 percent success — the company took every tract on which it bid — and said they'll have to cull some tracts to get below the state's 500,000-acre limit.

The tracts Great Bear took are primarily a large block south of Kuparuk and Prudhoe.

State of Alaska Division of Oil and Gas Director Kevin Banks said after the sale that the Great Bear sweep was somewhat analogous to last year's North Slope sale, when Denver-based

Armstrong took 68 tracts (it bid on 69) of 80 at the sale, for \$7.6 million in apparent high bids.

Duncan said he and Bob Rosenthal, the company's vice president of new ventures, have both worked in Alaska in the past and have a good understanding of petroleum systems on the North Slope.

There are five principals in Great Bear Petroleum, he said, and while only he and Rosenthal have worked in Alaska, all the principals are long-time colleagues.

Duncan said Great Bear believes "there are expansive new plays" in the area of its leases.

The Texas-based company plans to open an Anchorage office and Duncan said he and Karen Bryant Duncan, the firm's vice president-corporate and general counsel, will be relocating to Anchorage in the spring.

*Editor's note: Internet research gave this address for Great Bear: 54 Mill Point Place, Spring, Texas 77380-5402. Spring is just north of Houston.*

## Exxon: Point Thomson wells successful

By KAY CASHMAN  
Petroleum News

On Oct. 27 ExxonMobil announced that it had successfully drilled and tested the PTU-15 and PTU-16 development wells for the Point Thomson project on Alaska's eastern North Slope, "ahead of the year-end 2010 target."

Exxon has previously said it expected to begin production of 10,000 barrels a day of gas condensate from the project by the end of 2014. (See company profile on page 92.)

Exxon's Alaska Production Manager Dale Pittman was quoted in the late October press release as saying, "The successful drilling and testing of these wells represents a significant accomplishment and demonstrates we are delivering on our commitments. Many Alaskans contributed to this milestone,

completing work ahead of schedule in a safe and environmentally responsible manner."

Point Thomson is a remote natural gas and condensate field approximately 60 miles east of Prudhoe Bay. It is farther east than any development to date by about 40 miles. PTU-15 and PTU-16 were the first wells drilled in the field since 1983.

It is estimated to hold about 25 percent of the North Slope's discovered gas resources. "Concurrent with the drilling of these two development wells, activities are also focused on engineering and environmental permitting which are critical for project development," Exxon's release said.

To date about \$1.5 billion, including more than \$730 million in the last two years, has been invested in Point Thomson, Exxon said.

The Point Thomson project includes gas cycling facilities designed to recover hydrocarbon liquids and re-inject natural gas back into the reservoir, making Point Thomson "the highest-pressure gas cycling operation in the world," Exxon said.

### Working out legal issues

"The project is providing jobs and investment in Alaska," said Pittman. "We are continuing to work with the State of Alaska to resolve outstanding issues in order to maintain the pace and momentum of Point Thomson development," referring to legal battles with the state, which are partly on hold while the parties try to work out a mutually acceptable settlement.

The state has been legally seeking to reclaim the state-

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see POINT THOMSON page 19

**POINT THOMSON** *continued from page 18*

owned acreage at Point Thomson on grounds that the leaseholders neglected to develop the field after its 1977 discovery.

Point Thomson natural gas, Pittman said, is “critical to the success of an Alaska gas pipeline project.”

The two recent wells were drilled to a measured depth of more than 16,000 feet, Exxon said. The shore-based Nabors 27-E rig drilled directionally under the Beaufort Sea to the targeted gas reservoir more than 1.5 miles offshore.

The Point Thomson reservoir is “abnormally pressured in excess of 10,000 psi,” Exxon said, noting that more than “150 companies have been working to safely advance development of the field in an environmentally responsible manner.”

Preparation of the Environmental Impact Statement and design work on the facilities (known as Front End Engineering Design or “FEED”) are now “well advanced,” Exxon said in its release.

The U.S. Army Corps of Engineers is in charge of preparing the EIS for the project, and an Exxon affiliate has applied for a state right of way to build a 22-mile pipeline to carry Point Thomson liquids west to Badami to hook into the existing North Slope pipeline network.

The Corps originally estimated it would sign a “record of decision” on the project in July 2011 and publish it in August 2011. The need for an EIS was triggered by Exxon’s application for a Corps wetlands permit.

Now the target date is Jan. 19, 2012, the Corps says.

**IRWIN** *continued from page 16*

thing seems to have been streamlined. The state agencies have been very supportive of the project. From our perspective it’s been a very well-defined, streamlined process.”

Large resource development projects typically require many authorizations from numerous state and federal agencies. Some of the most important authorizations are federal authorizations that are beyond the state’s control. Most of the delays experienced in recent permitting of resource development projects have been the direct result of the action — or inaction — of federal agencies.

Moving forward with development of the OCS is urgent due to the time it takes to move from exploration to production. Time is also a critical factor for North Slope resource development. Currently, oil throughput is declining in the TAPS. At the same time we have seen the conclusions of successful open seasons for two competing gasline projects. Access to the OCS will spur more exploration and production of oil to fill the TAPS and will make natural gas available to fill a large natural gas pipeline.

There is growing recognition that our country will migrate to cleaner and more renewable sources of energy in the years to come. By working together with federal agencies and the industry to open access in the Arctic Alaska, including the OCS, we can sustain oil production for our country’s near term needs. We can also develop our vast, clean natural gas resource as a transition to an energy future that is more reliant on renewable resources.



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# Chevron pulls plug

*Cook Inlet assets for sale, holding onto North Slope, ANWR leases*

By KRISTEN NELSON  
Petroleum News

**C**hevron said Oct. 12 that it plans to market all Cook Inlet assets owned by Union Oil Company of California and Chevron U.S.A. Inc.

Chevron said producing properties will be offered as a single package. Marketing efforts are expected to begin in the near future. The company has a workforce of some 450 employees and contractors in Alaska.

"We are proud of our legacy and the dedicated and talented workforce that has developed and operated these assets safely and responsibly for many years," John Zager, general manager for Chevron in Alaska, said in the company's statement. "We will continue to focus on safe and reliable operations as we pursue the opportunity for another company to acquire these assets and further develop their potential," he said.

"We believe that finding a company that views the Cook Inlet as a vital, core asset will benefit the employees, the community and the state in the long run," Zager said.



JOHN ZAGER

JUDY PATRICK

## Update

Except for the P. 18 lease sale story, all items in *On Deadline* are updates for stories in the rest of this magazine.

Assets to be divested include interests in the Granite Point, Middle Ground Shoals, Trading Bay and MacArthur River fields; interests in 10 offshore platforms; interests in onshore gas fields including the Ninilchik unit and the Beluga River unit; and two gas storage facilities.

Chevron said current net production from the assets is approximately 4,000 barrels of oil per day and 90 million cubic feet of natural gas per day.

Concurrent with the Cook Inlet producing property divestitures, Chevron said it will also include the divestiture of its interests in the Cook Inlet Pipe Line Co. and the Kenai Kachemak Pipeline.

## From the beginning

Chevron acquired Unocal in 2005. Both companies have long histories in Cook Inlet, as indicated by field discoveries with which the companies are credited.

Cook Inlet fields discovered by Chevron (Standard Oil Company of California when early discoveries were made in the 1960s) include Beluga River (1962); Ivan River (1966); Falls Creek (1961) — now part of the Ninilchik unit; North Fork (1965); and Stump Lake (1978).

Cook Inlet fields discovered by Unocal include Trading Bay (1965); McArthur River (1965); the Kenai gas field (1959); Pretty Creek (1979); and Sterling (1961).

But it's a long time since a major discovery in Cook Inlet. Crude oil production peaked in 1970 at more than 227,000 barrels per day and, today averages less than 10,000 bpd. Natural gas production peaked in 1996 and is also in decline.

## A last hurrah

After Chevron acquired Union in 2005 there was concern that the Cook Inlet assets might be sold off, but as Zager told committees of the Alaska Legislature in March 2006, the Alaska team worked hard to convince Chevron management that the assets were worth keeping, and Chevron approved a multiyear investment program for Cook Inlet, even though "Cook Inlet offshore assets are financially challenged."

Unocal's Cook Inlet wells produced 200,000 barrels per day at a peak in the 1970s, Zager said, but in 2006 production was closer to 12,000 bpd.

Attempts to increase production from existing assets have been disappointing. In March 2008, Chevron drilled two wells to try to bring on new oil from the Anna platform in the Granite Point field, but the company said in November 2008 that results from those Anna wells were disappointing.

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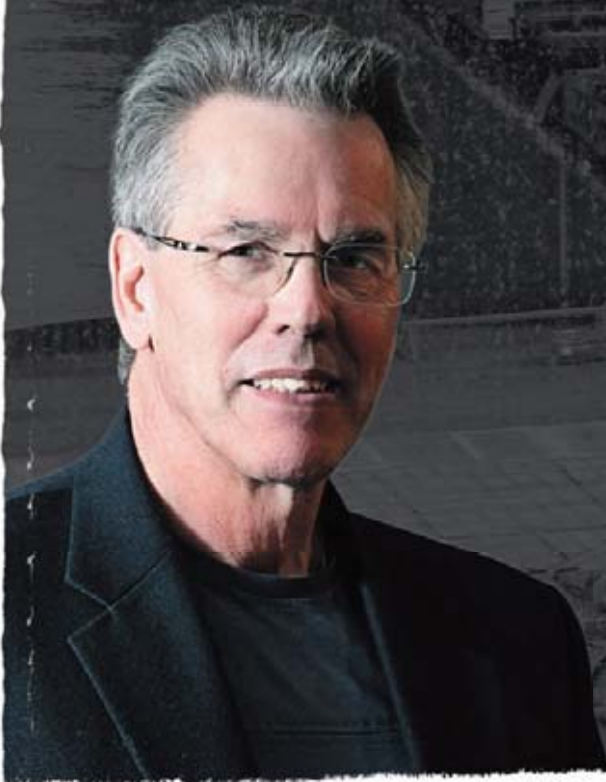
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see CHEVRON page 23

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## Linc spuds first Alaska well

Linc Energy has spud its first Alaska exploration well, the company said Oct. 24.

The Australian company recently began drilling LEA No. 1, an onshore vertical well located just north of Point MacKenzie Road across Knik Arm from Anchorage. (See company profile on page 35.)

"The well has been designed to target a number of stacked gas objectives whilst intersecting regional coal measures," Linc Energy CEO Peter Bond said in a prepared

statement.

Bond said the quick turnaround on the leases acquired earlier this year demonstrated Linc's commitment to the U.S. energy market.

"These Alaskan assets will be a definitive part of the early cash-flow opportunities for Linc Energy in the months ahead," Bond said. "I look forward to updating the market on the results from LEA No. 1 and the expansion of our operations and exploration activities within Alaska in due course."

Linc previously said it hoped to use revenue generated from the traditional exploration program to fund underground coal gasification projects in the Cook Inlet basin.

—Eric Lidji

## USGS slashes NPR-A oil estimate

In a revised resource assessment for the National Petroleum Reserve-Alaska released Oct. 25, the U.S. Geological Survey has reduced its estimate of undiscovered oil in the reserve from 10.5 billion barrels to 896 million barrels. The agency's estimate of undiscovered natural gas has dropped slightly from 61 trillion cubic feet to just under 53 trillion cubic feet.

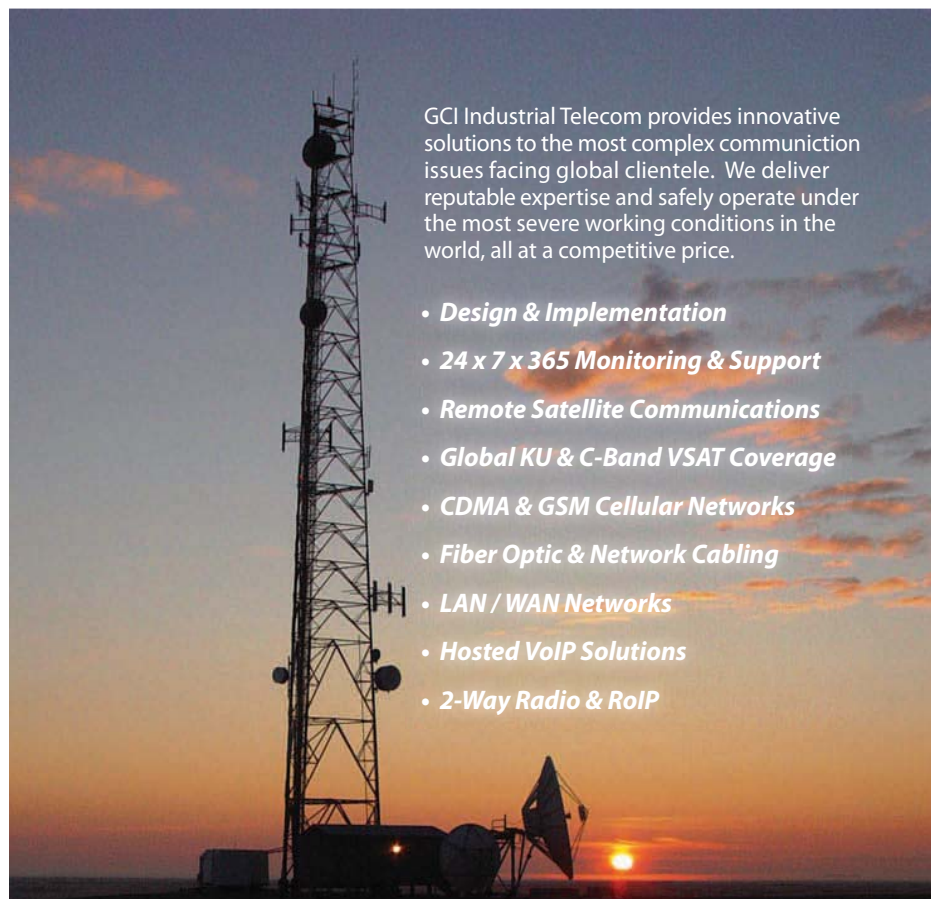
*USGS now thinks that the best bet for finding new oil in NPR-A is in a relatively young and shallow sequence of rocks known as the Brookian, with these rocks also likely to hold substantial amounts of natural gas.*

The revised estimates, coming as an update to an NPR-A assessment done in 2002, result from data now available from exploration wells drilled in the past decade. The data indicate an abrupt change from oil prone to more gas prone resources in NPR-A, just 15 to 20 miles west of the Alpine oil field in the Colville River Delta, USGS scientists think. Consequently, oil plays analogous to the Alpine field in NPR-A likely contain very little oil west of the area that ConocoPhillips and Anadarko Petroleum have been exploring around their Lookout and Alpine West prospects, USGS now says.

USGS now thinks that the best bet for finding new oil in NPR-A is in a relatively young and shallow sequence of rocks known as the Brookian, with these rocks also likely to hold substantial amounts of natural gas.

USGS attributes the apparent prevalence of gas in NPR-A to the pushing upward of rock strata between 60 million and 15 million years ago, a process that the agency says would have reduced the pressure on the rocks and, hence, caused degassing from oil deposits and an expansion of gas pools.

—Alan Bailey





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## Unocal gives up more White Hills leases

Union Oil Co. of California further reduced its holdings in the White Hills area in September, according to reports from the Alaska Department of Natural Resources. (See company profile on page 79.)

The company, an affiliate of Chevron, relinquished three leases totaling 16,890 acres in the oil and natural gas play in the central North Slope, south of the Kuparuk River unit.

Unocal also sold five leases totaling 28,694 acres in the White Hills area to 70 & 148 LLC, the North Slope subsidiary of Denver-based independent Armstrong Oil and Gas.

Most of the leases expire in January or August 2012, with one expiring in August 2014.

In recent months, 70 & 148 has built a large land position near White Hills.

The three relinquished leases each include a proposed drilling location or an actual well site: ARCO's Toolik Federal

No. 3 well, Unocal's Bluebuck 6-7-9 well drilled in early 2009 and Unocal's proposed Moropus 16-6-8 well site. The five sold leases include four well sites: Texaco's Wolfbutton 32-7-8 well, Unocal's Muskoxen 36-7-8 well drilled in 2009, BP Exploration's Narvaq No. 1 well and Chevron's Ruby State No. 1 well.

The results from Bluebuck and Muskoxen won't become public until 2011.

Unocal retained four leases in the White Hills area. Those leases include one proposed well location, Unocal's Diniotis 28-9-9 well, but no actual drill sites.

Chevron operated the White Hills exploration program and holds a 70 percent interest in the leases. A subsidiary of the French major Total holds the remaining 30 percent.

Chevron took on White Hills after acquiring Unocal in 2005. The two-year program marked the first North Slope exploration program for the major since the 1990s.

—Eric Lidji

## CHEVRON *continued from page 20*

Mother Nature didn't help, either: All oil production on the west side of Cook Inlet was put on hold after Mount Redoubt volcano erupted in early 2009, causing the temporary shut-in of the Drift River oil terminal at the base of the volcano — the only means of exporting oil from west side platforms and fields.

The terminal reopened in August 2009, but the tank farm was bypassed and tanker loading was from oil piped directly to the Christy Lee platform offshore the terminal from storage tanks at the Granite Point and Trading Bay production facilities. The terminal shut-in caused oil fields on the west side to be shut-in for several months, with possible long-term impacts on field production rates.

### No longer of interest

As Cook Inlet production declined over the years, properties have changed hands among operators.

Past consolidations left Unocal the dominant oil producer in the area while Marathon — another early Cook Inlet player — became a gas-only producer.

Smaller operators have come and gone, but Cook Inlet lost one major in 1998 when Shell, which operated two platforms in Cook Inlet's Middle Ground Shoals field, sold that interest to XTO (recently acquired by ExxonMobil), which did more drilling from the platforms.

That is evidently the type of company Chevron is hoping to attract to its Cook Inlet assets — a smaller company which would focus on developing remaining resources from existing facilities.

### North Slope interests

Chevron will retain its North Slope interests which include: a 10.52 percent working interest in the Endicott participating area at the Duck Island unit (acquired with the Unocal purchase); a 4.95 percent working interest in the Kuparuk River unit (also from the Unocal purchase); a 25.14 percent working interest in the terminated Point Thomson unit, under litigation between the companies and the State of Alaska; a 1.16 percent interest in the Prudhoe Bay

unit; and leases in the Arctic National Wildlife Refuge, where operator Chevron was a partner with BP in the KIC well. Chevron also holds, through Unocal Pipeline Co., a 1.36 percent ownership in the trans-Alaska oil pipeline.

The companies have approximately 62,125 net acres on the North Slope, including acreage at White Hills on the central North Slope south of the Kuparuk River unit where Chevron has drilled exploration wells in recent years.

What is ALASKA?

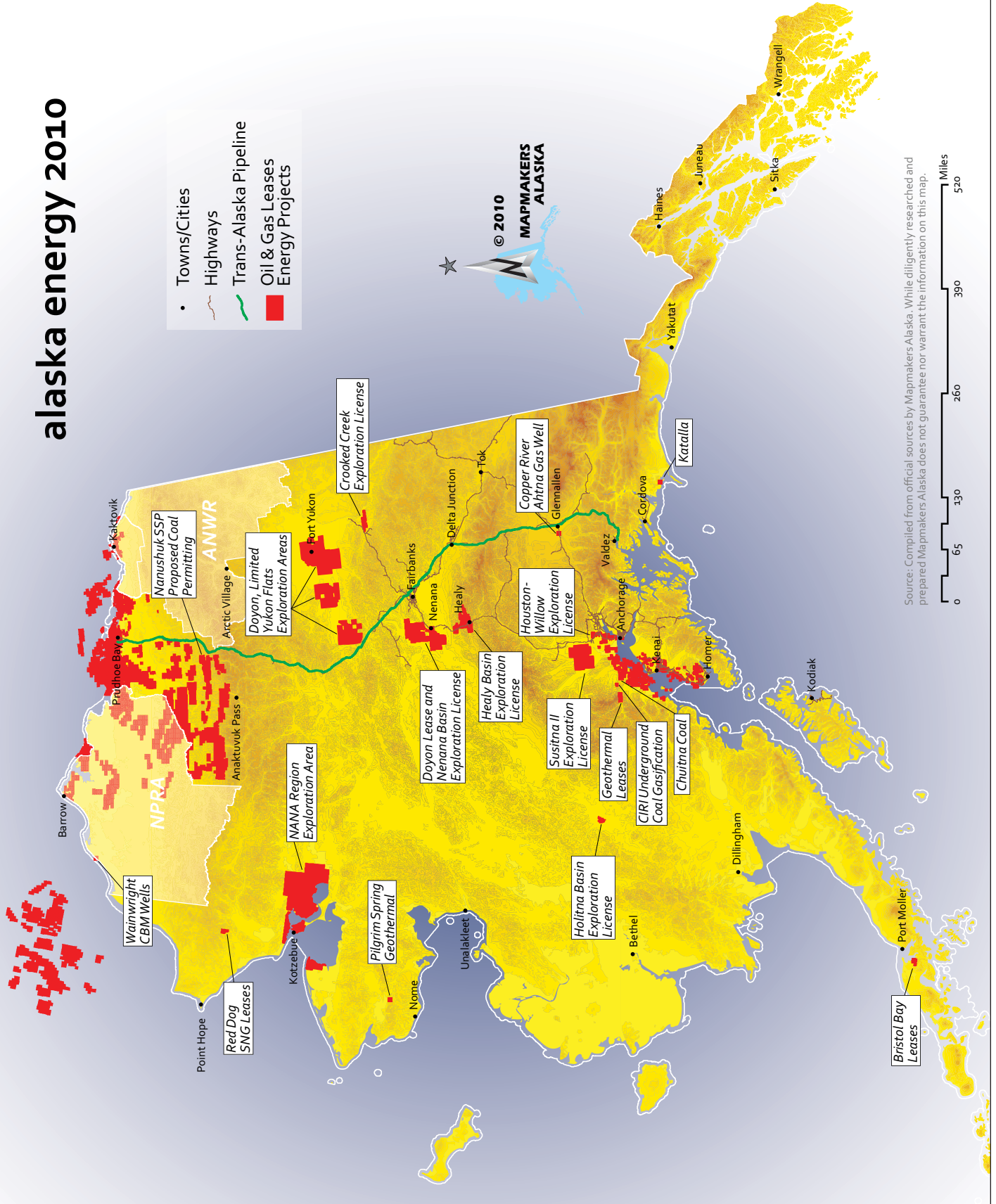
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The Triassic Kamishak formation exposed at Puale Bay. (See Petroleum News story at): <http://www.starzhost.com/petroleumnews/pdfarch/895592024.pdf#page=1>

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## Alaska Peninsula & North Aleutian basin

By Alan Bailey  
Petroleum News Senior Staff Writer

**T**he North Aleutian basin, also known as the Bristol Bay basin, extends more than 200 miles along the north side of the Alaska Peninsula and out into the southern Bering Sea shelf. The southeastern portion of the basin underlies state land and nearshore waters along the northwest side of the Alaska Peninsula, from north of Egegik to the southwest side of Herendeen Bay. The deepest part of the basin lies in the federal outer continental shelf, offshore Port Moller, on the southeastern side of the Bering Sea.

There are two distinct rock sequences with petroleum potential in the Bristol Bay and Alaska Peninsula region. The first, a sequence of Mesozoic strata, is well exposed along the southeastern coast of the peninsula, is associated with some well known oil seeps and was the target of early oil exploration in the region. The second sequence consists of younger Tertiary rocks that form the fill of the North Aleutian basin itself and that are well exposed onshore the peninsula near Port Moller.

People generally consider that biogenic gas, gas resulting from the bacterial decomposition of organic material, is likely to prove the most significant hydrocarbon resource in the region. This type of gas could occur in virtually any part of the basin

that hasn't become hot enough to kill the gas-generating bacteria. But an analysis of natural gas from a well known seep in Mesozoic rocks between Port Moller and Herendeen Bay provided evidence for the possibility of plays involving thermogenic gas that has formed from the heating of organic material. Furthermore, some of the gas sampled from Tertiary sandstones in the most recently drilled onshore well, the Becharof No. 1 well from 1985, also yielded a clear thermogenic signature.

The strip of state waters along the northwest lowlands of the peninsula includes subsided fault blocks with thermally mature, organic-rich Tertiary rocks. These rocks show some potential to generate thermogenic hydrocarbons. If such Tertiary petroleum kitchens exist, the most likely hydrocarbon product would be natural gas, perhaps along with condensate or lesser high-gravity paraffinic oils.

### Hydrocarbon potential long known

People have known about the oil and gas potential of the

*continued on next page*



Alaska Peninsula region since the mid-1800s — at that time the Russians discovered oil and gas seeps around the Iniskin Peninsula area on the west side of Cook Inlet. Fourteen oil seeps and four gas seeps are now known to exist between the Iniskin Peninsula and the area around Sand Point toward the southwestern end of the peninsula. Geologists have found at least two outcrops of oil-bearing rocks.

This evidence of an active petroleum system in the area has spurred exploration activity at various times since the early 20th century. Much of this exploration has focused on the Cook Inlet and Shelikof Strait side of the Alaska Peninsula and the onshore portion of the North Aleutian basin on the northwest side of the peninsula.

Two phases of early exploration drilling occurred in the early 1900s and in the 1920s. This drilling targeted relatively shallow rock formations near oil seeps along the southeast side of the Alaska Peninsula. None of the wells found commercial quantities of oil. A deeper well drilled on the peninsula by a major oil company in 1940 also failed to find commercial quantities of oil.

Between 1955 and 1974 a flurry of exploration activity in the Bristol Bay area resulted in some seismic surveys and 16 exploration wells, 10 of which penetrated the North Aleutian basin. In 1977 Phillips drilled an exploration well on the south side of the Alaska Peninsula, southeast of Port Moller. In 1982 and 1983 more than 20 companies participated in the drilling of a stratigraphic test well, the North Aleutian Shelf COST No. 1 well, in the deepest part of the basin offshore Port Moller. In 1985 Amoco drilled, plugged and abandoned an onshore well near Becharof Lake.

Among the 26 wells drilled on the Alaska Peninsula and the offshore North Aleutian Shelf COST No. 1 well, 19 wells encountered oil shows and 13 encountered gas shows. Three of the oil shows were very poor or minor and one consisted of oil residue. Data from three wells measured modest to moderate gas flows, with flow rates of 5,000 to 9,000 cubic feet per day, 10,000 to 90,000 cubic feet per day and 450,000 to 700,000 cubic feet per day.

Exploration in the Bristol Bay area has resulted in many thousands of line-miles of seismic data, much of it offshore. However, the North Aleutian Shelf COST No. 1 remains the only offshore well in the North Aleutian basin and no wells have been drilled in the Bristol Bay area since the 1985 Amoco well.

## Modern lease sales, current interest

Although there has been continuing oil industry interest in the Bristol Bay region, federal prohibitions on oil and gas leasing in the North Aleutian basin have prevented new offshore exploration in the region and have dampened interest in onshore exploration on the Alaska Peninsula.

Between 1989 and 2007, following the Exxon Valdez oil spill in Prince William Sound, the federal government prohibited oil and gas leasing in the outer continental shelf waters of the Bristol Bay area, the location of several major fisheries, including world-class pollock and salmon fisheries. In January 2007 President Bush lifted the federal moratorium, thus enabling the U.S. Minerals Management Service to include one North Aleutian basin lease sale in its 2007 to 2012 outer continental shelf leasing program. The lease sale would have only included an area of about 5.6 million acres west of Port Moller and north of King Cove, rather than the entire MMS North Aleutian Planning Area.

MMS said the area is believed to be gas-prone, with perhaps

8.6 trillion cubic feet of technically recoverable natural gas and 753 million barrels of technically recoverable oil and condensate in the federal offshore part of the basin.

As work progressed on a lease sale environmental impact statement, a proposed lease sale, scheduled for 2011, triggered controversy around the potential impact of oil and gas development on the fisheries and on subsistence hunting in the region. While some local communities said that offshore oil and gas activities posed too high a risk of long-term harm to fishing, others expressed support for oil and gas development as a means of improving a local economy dogged by escalating fuel costs, a depressed fishing industry and a lack of employment opportunities.

At a North Aleutian basin Energy-Fisheries Workshop held in March 2008, a Shell executive described a possible scenario for future natural gas production, in which perhaps three to six steel or concrete platforms a few miles offshore in the Bering Sea would connect by pipeline to a liquefied natural gas plant on the south side of the Alaska Peninsula near Port Moller. Shell has made no secret of its interest in the North Aleutian basin as a possible area for future gas development.

The inauguration of President Obama in 2009 brought in a new U.S. administration with a new environmental agenda and in April 2010, as part of a new U.S. policy for oil and gas leasing on the outer continental shelf, the Department of the Interior announced that it was withdrawing the Bristol Bay area from future oil and gas leasing.

The 2007 to 2012 OCS lease sale program had also become the subject of legal action. In April 2009 the United States Court of Appeals for the District of Columbia upheld an appeal by the Native Village of Point Hope and several environmental organizations against the program, with the court ordering Interior to withdraw the program because, the court said, Interior had not done an adequate analysis of the environmental sensitivity of areas impacted by planned lease sales.

The court later clarified its ruling by saying that its order only related to planned Alaska lease sales in the Beaufort Sea, the Chukchi Sea and the North Aleutian basin, and that the court was delaying its decision on the Alaska lease sale program while DOI reworked its environmental analysis of the Alaska sales. DOI has yet to deliver a final version of its revised EIS to the court, although the federal withdrawal of the Bristol Bay region from oil and gas leasing presumably renders the court case moot with respect to the North Aleutian basin.

## State of Alaska lease sales

Meantime the State of Alaska, seeing the Bristol Bay area as a potential new oil and gas province, has been encouraging oil and gas exploration onshore and along the coast through a program of areawide lease sales for state lands and adjacent state waters. The area of potentially leasable acreage extends along the northwestern lowlands of the Alaska Peninsula from the east end of Bristol Bay to a point southwest of Port Moller.

In parallel with the lease sales, a team led by Alaska's Division of Geological and Geophysical Surveys conducted a three-year research program on the Alaska Peninsula, doing field work to fill in detail about the petroleum potential of the rock sequences of the region, and placing data from earlier exploration programs into a modern petroleum geology context.

The DGGs-led research has included many subprojects, including the analysis of measured sections in exposed rock strata;

*continued on page 29*

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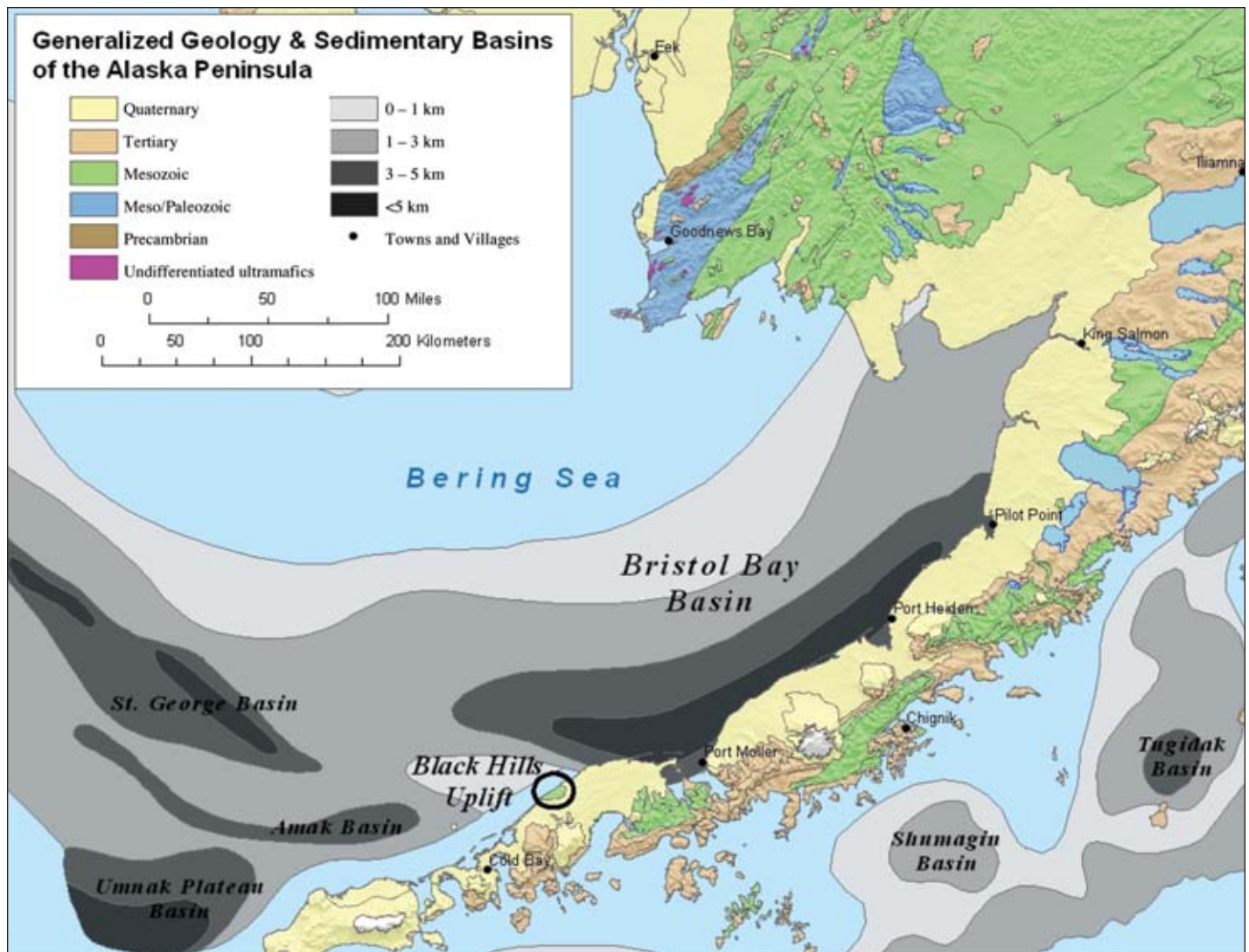
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Generalized geology (modified from Beikman, 1980) of the Alaska Peninsula area, showing sedimentary basin thickness (courtesy of DOG) for Bristol Bay and surrounding basins.

geologic mapping and evaluation of potential structural traps across the region; new interpretations of the structural and sedimentary history of the Alaska Peninsula; and geochemical analyses to document the source and reservoir characteristics of various rock formations.

At the first of the state areawide lease sales in October 2005 Shell Offshore Inc. purchased leases on about 190,000 acres onshore and offshore around Herendeen Bay and Port Moller. Shell appeared to be targeting the southern edge of the North Aleutian basin and the northern edge of large geologic structures immediately to the south of the basin — the leases appeared to offer both Mesozoic and Tertiary plays in an area with significant potential for structural traps.

At the same sale Hewitt Mineral Corp. purchased four tracts straddling the margin of the basin, on the southwest side of Herendeen Bay. Hewitt targeted a major anticline in the Mesozoic but also saw potential Tertiary plays below a major fault that has pushed the Mesozoic strata over Tertiary rocks of the basin.

The second state areawide lease sale in February 2007 only resulted in the sale of one lease, an extension to Hewitt's Herendeen Bay holdings. The subsequent sales in 2008, 2009 and 2010 drew no bids.

### Interest mainly in offshore

Lack of interest in the state sales held to date suggests that exploration interest lies offshore in the deepest and most prospective part of the North Aleutian basin.

In February 2009 Shell relinquished all of its leases from the 2007 lease sale, saying that these leases no longer fitted into the company's exploration plans, although the company was still considering the possibility of offshore exploration in the region.

Hewitt conducted some geologic research in association with its Alaska Peninsula leases, eventually determining that a well 14,000 to 15,000 feet deep would be required to test all the stratigraphy with exploration potential in the geologic structure it had leased. And, presumably needing another investment partner or two to share the cost and risk of such a major drilling project, the company has not yet done any further work to explore its acreage.

## Geology of Alaska Peninsula

The geological history of the Alaska Peninsula and the North

*continued on next page*



Aleutian basin relates closely to that of the Cook Inlet basin to the northeast — both basins formed along zones where the Earth's crust warped downward during the Tertiary period. More than 20,000 feet of Tertiary sediments have accumulated in the deepest part of the basin. These sediments lie in juxtaposition with a 25,000- to 30,000-foot sequence of older Mesozoic sediments.

### Mesozoic seas

In the Mesozoic era, prior to the late Cretaceous, a wide area of southern Alaska, including the Bristol Bay, Cook Inlet and North Aleutian basins, lay under seas bordered by volcanic arcs. As a result, a sequence of broadly similar Mesozoic rocks extends under or alongside all of these basins.

But in the Alaska Peninsula these Mesozoic rocks form two very distinct sets: a broad area of thermally altered rocks to the west of a major fault, the Bruin Bay fault, that marks the west side of the Cook Inlet basin, and a sequence of Permian to late-Cretaceous sedimentary rocks on the east side of the fault. The rocks on the west side of the fault have no petroleum potential, while the rocks on the east side of the fault include the oil source rocks of the Cook Inlet basin oil fields, as well as several other potential source rock horizons and potential oil and gas reservoirs.

The surface manifestation of the Bruin Bay fault disappears at Becharof Lake, toward the northeast end of the Alaska Peninsula, and the absence of surface evidence for what happens south of the lake has led to speculation about where the boundary between the two sets of Mesozoic rocks runs under the peninsula and the offshore. The location of the boundary is of great significance in assessing the petroleum potential of some parts of the region.

Evidence from the Great Basins No. 1 well on the Alaska Peninsula has been interpreted by some geologists to suggest that the boundary may run east-west somewhere north of Pilot Point near the northeastern end of Bristol Bay. Granite like igneous rocks of Jurassic age under the northeastern part of the North Aleutian basin have also cut through the older Mesozoic strata in that area.

And, unfortunately, since no wells have penetrated the base of the offshore component of the North Aleutian basin, no one knows for sure whether Mesozoic strata with petroleum potential lie under the Tertiary rocks in the basin, as happens under the Tertiary fill of the Cook Inlet basin.

An MMS assessment of the North Aleutian basin published in 2006 postulated that the boundary passes east to west offshore from a point northeast of Port Moller. This interpretation of the boundary location leads to the conclusion that the petroliferous Mesozoic sediments are absent from most of the outer continental shelf section of the basin. The interpretation is based on patterns of magnetic anomalies and the absence of evident stratification

in the Mesozoic basement, as seen in offshore seismic sections.

A DGGS-led team researching the Alaska Peninsula geology used primarily aeromagnetic data to identify a major structural dislocation called the Becharof discontinuity, trending north-west from the known southern limit of the Bruin Bay fault. Southwest of the discontinuity lies a newly described segment of the North Aleutian basin, termed the Ugashik subbasin. And to the east of the Ugashik subbasin a system of faults known as the Ugashik Lakes fault system, runs southwest from the Bruin Bay fault down the peninsula to the southern boundary of the North Aleutian basin in the Port Moller area.

If the Ugashik Lakes fault system represents the southern continuation of the Bruin Bay fault, that might suggest that petroleum bearing Mesozoic rocks are indeed absent under the deep part of the North Aleutian basin.

On the other hand, well data from the Black Hills area, on the Alaska Peninsula south of Port Moller, show a substantial thickness of Mesozoic sedimentary strata on the immediate southwest side of the steep southern flank of the basin. And a seep of thermogenic gas from lower Cretaceous rocks between Port Moller and Herendeen Bay points to the existence of hydrocarbon-bearing Mesozoic rocks under that location.

### Emerging land

The onset of the Tertiary period in the North Aleutian basin area marked a change of sedimentary environment from a marine shelf to an environment that oscillated between terrestrial and shallow marine settings. Rivers deposited huge volumes of silt, sand and pebbles into the subsiding basin. The resulting Tertiary stratigraphy, observed on land near Port Moller and extrapolated into the depths of the North Aleutian basin, includes sandstones, organic-rich mudstones and coal.

And the strata both onshore and offshore contain an abundance of large folds, faults and other features that could provide structural traps for oil and gas.

### Mesozoic hydrocarbon potential

At least two formations within the Mesozoic rocks appear to contain good potential source rocks for hydrocarbons. Both potential sources are oil prone.

The age and composition of the first of these sources, the late Triassic Kamishak formation, resemble the Shublik formation, a major source rock on the North Slope. The Kamishak formation also resembles an oil shale, the Glenn shale, which is associated with the Yukon Flats and Kandik basins in east central Alaska. Well samples have demonstrated that the Kamishak formation is thermally mature at depth.

The other potential source rock is in the middle Jurassic Kialagvik formation that is equivalent to the Tuxedni formation, the main source of oil in the upper Cook Inlet basin. Analysis of rocks of the Kialagvik formation has shown carbon and hydrogen content that could support oil formation; hydrocarbon samples contain similar isotope compositions to the oil seeps and oils of the Cook Inlet oil fields.

Coal beds in the late Cretaceous Chisik formation could also support the generation of dry gas.

### Reservoir potential

Several formations within the Mesozoic include sandstones and conglomerates that could form oil and gas reservoirs. These potential reservoirs attain thicknesses up to several thousands of feet. Compaction and alteration of the sediments at great bur-



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ial depths may limit reservoir quality, although extensive fracturing could also have turned the rocks into effective gas reservoirs. The prevalence of volcanic material in the rocks gives rise to chemistry that is conducive to the formation of pore-clogging minerals. More fieldwork might determine whether some of the Mesozoic units transition laterally into better quality reservoirs.

Some 2006 fieldwork and subsurface analysis by Hewitt Mineral Corp. has also found reservoir potential in what appears to be hydrothermal dolomite in a thick carbonate sequence of the Triassic Kamishak formation, in close proximity to potential Kamishak source rocks.

However, although extensive folding and faulting of Mesozoic rock strata across the region has given rise to many potential oil and gas traps, the migration of the hydrocarbons into a younger and shallower Tertiary reservoir, as has happened in the oil fields of upper Cook Inlet, may be the most promising scenario for an oil or gas field, given the likely degradation of the Mesozoic reservoirs.

### Tertiary hydrocarbon potential

All of the Tertiary formations in the Bristol Bay area contain organic material and most contain coal. Thermal maturities in many areas appear to be low or marginal for thermogenic hydrocarbon generation, but these organic-rich sediments could certainly have generated significant volumes of biogenic gas — 90 percent of the more than 9 trillion cubic feet of natural gas extracted from equivalent rocks in the upper Cook Inlet has proved biogenic in origin.

However, recent analysis of geochemical data from the North Aleutian Shelf COST No. 1 well offshore in the North Aleutian basin has shown thermal maturities within the oil window in Tertiary rocks at depths below 12,300 feet and the existence of material that could generate at least minor amounts of oil in addition to thermogenic gas.

The east-west structural grain in the deep, southern part of the basin coupled with the steep basin flank on the southeastern side suggest that the deeper, more thermally mature parts of the basin could extend under the lowlands of the Alaska Peninsula, north of Port Moller. However, there is no seismic or well data to either support or disprove that theory.

There is seismic evidence for possible gas chimneys in Terti-

ary strata offshore the Black Hills area, west of Port Moller.

### Potential reservoirs

Several formations within the Tertiary include candidate reservoir rocks. Reservoir quality seems variable and depends on the extent to which the rocks have undergone chemical alteration. However, two of the formations, the Oligocene Unga-equivalent and Miocene Bear Lake formations, contain substantial thicknesses of good reservoir sandstones and conglomerates. The Pliocene Milky River formation exhibits good reservoir properties but lies at such shallow depths that overlying seals capable of holding hydrocarbons in the reservoir are probably lacking.

The lack of a thick, regionally blanketing shale seal unit in the shallow section above the best reservoir-quality sands is a source of concern to some geologists. Others point to the stacked nature of Cook Inlet reservoirs, where hydrocarbons are contained in multiple sand layers, each capped by fairly thin nonmarine mudstones of only local extent. Any one mudstone horizon may only seal one pay zone and only on that one structure, but several stacked pay zones can add up to large reserves. Recent fieldwork on the Alaska Peninsula has revealed locally thick mudstones with good seal characteristics that appear to extend over at least prospect-sized areas.

The prevalence of folding and faulting in the area has given rise to many potential structural traps. And the geological setting supports the formation of stratigraphic or combination traps in the Tertiary sequence — the close interleaving of fine-grained and coarse-grained rocks together with lateral changes in the sediments has given rise to sedimentary packages that likely include well sealed reservoirs. Overall, there is a very good chance of finding gas in the Tertiary strata of the basin, in a very similar setting to the gas fields of Cook Inlet. Also there is a possibility of finding oil that has migrated from source rocks in the Mesozoic in areas where Tertiary reservoirs overlie Mesozoic strata.

In its most recent assessment of the North Aleutian basin, MMS thinks that on the outer continental shelf the most prolific petroleum plays are likely to involve thermogenic gas bubbling upward from Tertiary strata deep in the basin into sandstone reservoirs of the Tolstoi, Stepovak and Bear Lake formations, where these formations have draped into domes over raised faulted blocks.


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The Anna platform in the Granite Point field.

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## Cook Inlet basin

By Alan Bailey  
Petroleum News Senior Staff Writer

**C**ook Inlet, a major sea inlet between the Kenai Peninsula and the mainland of Southcentral Alaska, lies over part of a deep sedimentary basin that has formed between the Kenai Mountains and the mountains of the Alaska and Aleutian ranges. This basin, known as the Cook Inlet basin, became a focus of early Alaska oil and gas exploration, hosted the first major Alaska oil field and remains an active target for oil and gas exploration and production. In its entirety, the basin extends beyond Cook Inlet under the western side of the Kenai Peninsula, under the lower land on the west side of the inlet and under the waters of the Shelikof Strait.

### A changing business scene

The oil and gas industry of the Cook Inlet basin has evolved continuously in the decades since oil started flowing from the Swanson River field on the Kenai Peninsula in 1960. But the start of a major eruption of the Redoubt Volcano on the west side of Cook Inlet in March 2009 seemed to herald a period of significant change in the business environment for Cook Inlet oil and gas.

The Redoubt eruption caused the temporary shut-in of the Drift River oil terminal, located at the base of the volcano and the only means of exporting oil from the west Cook Inlet oil fields. The terminal reopened in August 2009, with its tank farm bypassed and with tankers having to periodically offload oil piped to Drift River directly from storage tanks at production facilities at Granite Point and Trading Bay. The terminal shut-in caused the aging oil fields on the west side of Cook Inlet to also

be shut-in for several months, resulting in an accelerated decline in already low oil production rates.

And, coincidentally, at around the time that Redoubt was starting to blow, Cook Inlet oil producer Pacific Energy, a 50 percent owner of the Drift River terminal, and of the Cook Inlet pipeline that delivers oil to the terminal, filed for bankruptcy. In addition to its interests in the terminal and pipeline, Pacific Energy owned substantial interests in oil and gas fields on the west side of the inlet.

Chevron, the other owner of the terminal and pipeline, obtained these facilities in 2005 when it purchased Unocal and all of Unocal's Cook Inlet oil and gas fields, as well as Unocal's production facilities. And, after intimating ambitious plans to extend the life of its offshore Cook Inlet oil fields and to explore for new oil reserves, in March 2008 Chevron drilled two wells to try to establish new oil reserves from the Anna platform in the Granite Point field, which lies on the west side of the Inlet.

But, after disappointing results from those wells and disruption to oil production as a consequence of the Redoubt eruption, the company's Cook Inlet plans now seem uncertain.

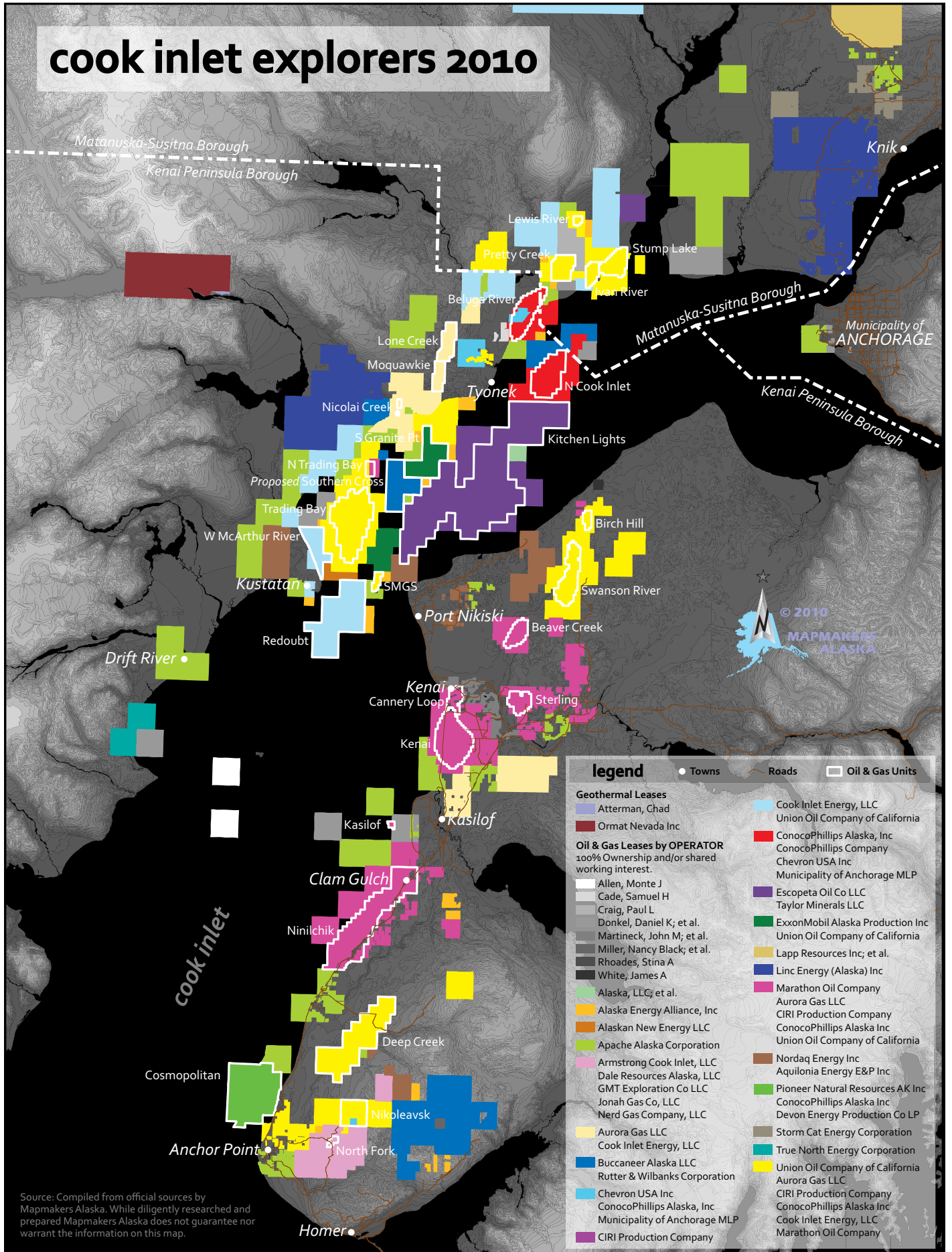
In November 2009, citing the oil production decline and the impact of the bankruptcy of Pacific Energy Resources, Chevron announced that it was laying off 25 of its Cook Inlet staff.

### New companies in the inlet

A month later Cook Inlet Energy, a subsidiary of Tennessee-based Miller Energy Resources, announced that it had purchased many of the Pacific Energy assets, including: the West

*continued on page 34*

# cook inlet explorers 2010



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Marathon's history in Alaska is intertwined with the history of the Cook Inlet basin. The Houston-based company arrived in Alaska in 1954 as the Ohio Oil Co., helped discover the Kenai gas field and began supplying Anchorage in 1961, a relationship that continues today. In 1969, the company partnered with what is now ConocoPhillips to build the first liquefied natural gas export facility in the country to ship Cook Inlet natural gas supplies to Asia. In 1996, Marathon sold its oil properties in Alaska to focus on natural gas.



**CARRI LOCKHART**

**NAME OF COMPANY:**  
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**TOP ALASKA EXECUTIVE:**  
Carri Lockhart, production manager, Alaska  
**MAIN ALASKA TELEPHONE:** 907-561-5311  
**MAIN ALASKA FAX:** 907-565-3076  
**COMPANY WEBSITE:** www.marathon.com



Marathon drilled nine wells in 2008, but only six wells in 2009. The company expects to drill between two and six wells per year in Alaska between 2010 and 2012. In March 2010, Marathon drilled an exploration well at the Sunrise prospect on Cook Inlet Region Inc. leases inside the Kenai National Wildlife Refuge, an item long on the

company's wish list. Marathon would only say it "encountered a zone of interest" with the well.

Marathon signed gas supply agreements with Enstar Natural Gas and Chugach Electric Association in 2010 and is asking the federal government for more time to export LNG.

**Current exploration focus:**

Cook Inlet: Marathon continues to develop its many Cook Inlet gas fields, but recently drilled an exploration well at the Sunrise prospect in the northern Kenai Peninsula.

McArthur River oil and gas field; the West Foreland gas field; the Redoubt oil field, with its Osprey offshore platform; the Kustatan onshore oil production facility; a 30 percent stake in the Three Mile Creek gas field; and more than 600,000 acres of exploration leases.

Cook Inlet Energy, run by ex-employees of Pacific Energy, has been successfully recompleting and restoring production from wells in its Cook Inlet properties, and in a May 2010 lease sale it acquired about 27,000 acres of additional state Cook Inlet leases. The company has also been embroiled in a dispute with Chevron over a hike in rates for the transportation of oil by pipeline to the Drift River terminal, following the disruption caused by the Redoubt eruption.

The company hopes to raise sufficient capital to drill five wells at West McArthur River over the coming year to increase

field production by more than 2,000 barrels per day.

Cook Inlet Energy acquired two offshore prospects, Raptor and Sabre, from Pacific Energy and has expressed an interest in drilling in the Raptor prospect, and from the Osprey platform. However, this drilling appears to be contingent on raising the necessary capital.

On the more easterly side of the Cook Inlet basin, ExxonMobil quietly became an oil producer in the basin when it bought out XTO Energy in late 2009: XTO operates the aging Middle Ground Shoal oil field in the middle of the inlet. ExxonMobil has yet to make an announcement about any Cook Inlet plans that it might have — Middle Ground Shoal represents just a tiny piece of the total XTO takeover.

Meantime, onshore the Kenai Peninsula, Chevron has been continuing to draw oil from the aging Swanson River field.

Around April 2010 Houston-based independent Apache Corp. flagged an interest in the Cook Inlet basin by meeting with staff from the Alaska Department of Natural Resources and by attending a DNR technical conference. And in July 2010 the company picked up nearly 200,000 acres in leases scattered around the

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Linc Energy isn't dilly-dallying in Alaska. The Australian company bought 123,000 acres from fellow independent GeoPetro Resources in March 2010 and immediately planned a drilling program. The acreage covers state, Cook Inlet Region Inc., and Alaska Mental Health Trust Authority land in two prospects, one near Point MacKenzie along the western bank of Knik Arm, and the other at Trading Bay on the west side of Cook Inlet.

Linc plans to drill the LEA No. 1 well near Point MacKenzie in October to look for conventional natural gas resources, but longer term the company is focused on generating synthesis gas from deep coal deposits using Underground Coal Gasification.

**Current exploration focus:**

**Cook Inlet:** Linc plans to drill a natural gas exploration well

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 HEADQUARTERS OF PARENT COMPANY: Australia  
 HEADQUARTERS IN ALASKA: 3000 C St., Ste. 103, Anchorage, AK 99503  
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near Point MacKenzie in the fall of 2010. The drilling site is near an existing Enstar Natural Gas distribution line.

basin, purchasing the leases from a group of investors including Daniel K. Donkel and Samuel H. Cade. Apache has made offers for leases owned by some other Cook Inlet lease owners, including Escopeta Oil Inc., but at the time this publication went to press none of these offers had been accepted.

**Offshore drilling requires jack-up rig**

While the situation regarding existing oil and gas fields continues to evolve, there is considerable interest in exploring for oil and gas in some relatively large, known prospects that remain untested under the waters of Cook Inlet, in a geologic trend that extends southwest from ConocoPhillips' venerable

North Cook Inlet gas field, the offshore field that was established as the primary gas source for the Nikiski LNG plant on the Kenai Peninsula.

The offshore prospects include Northern Lights, Corsair, Kitchen and East Kitchen.

The Northern Lights prospect lies in a down dip extension of the undeveloped Sunfish oil discovery underneath the North Cook Inlet field. Corsair, in the middle of Cook Inlet to the southwest of Northern Lights, consists of a large NNE-SSW trending anticline with both gas and oil possibilities in multiple horizons. Kitchen lies along the same structural trend, southwest of Corsair. East Kitchen lies in an anticline about six miles northeast of Port Nikiski.

*continued on next page*

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Armstrong Oil and Gas introduced a business style to Alaska in late 2001, going after larger prospects passed over by majors BP and ConocoPhillips, the North Slope's only producer-operators at the time. Armstrong drilled wells quickly and brought on partners who explored and eventually developed prospects. Using that strategy, the Denver-based independent brought Pioneer Natural Resources, Kerr-McGee and Eni Petroleum to Alaska, leading to the development of the Oooguruk, Nikaitchuq and Tuvaq prospects.

Armstrong came to Alaska to look for oil on the North Slope, but since 2008 has focused on Kenai Peninsula natural gas. The company expects to bring the North Fork unit into production in early 2011, as soon as it completes a new pipeline system into the southern Kenai Peninsula. Armstrong also plans to drill more North

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ED KERR

Fork wells this year, including one to test oil prospects in the region. The company also continues to amass acreage on the North Slope through its subsidiary 70 & 148 LLC, picking up a block of leases south of the Kuparuk River unit and another block in the White Hills prospect, in addition to previously acquired state leases near the Oooguruk unit in the Beaufort Sea. Armstrong currently leases some 450,000 state acres, onshore and offshore across Alaska.

**Current exploration focus:**

**Cook Inlet:** Armstrong is leading a partnership developing the North Fork natural gas field in the southern Kenai Peninsula, and expects to bring the field online in early 2011.

**Northern Alaska:** Armstrong has acquired state acreage in the central North Slope and the Beaufort Sea, but has not yet announced any exploration or development plans.

The only one of these prospects that has ever been drilled is Corsair, where Shell, Phillips and ARCO drilled a total of five exploration wells between 1962 and 1993. The wells all had gas shows and some also tested small quantities of oil.

Unfortunately, drilling in any of the prospects would require bringing a jack-up rig to Cook Inlet, probably from the Gulf of Mexico, an expensive and financially risky undertaking.

**Independents push for jack-up**

However, for several years Houston-based independent Escopeta Oil, under Danny Davis, its president, has been championing the cause of using a jack-up rig to drill some new exploration wells in Cook Inlet. Escopeta has particularly fo-

cused on the Kitchen prospect, where Davis thinks that there might be 7.5 trillion cubic feet of natural gas and 1.7 billion barrels of oil, although the state has classified the prospect as "highly speculative."

In early 2006 Escopeta secured the use of a jack-up rig and subsequently obtained an unprecedented waiver to the Jones Act to enable the company to bring the rig to Cook Inlet from the Gulf of Mexico on a foreign-flagged vessel. But the company then ran into problems shipping the rig north and postponed its drilling plans.

Subsequently Pacific Energy, having obtained the Corsair unit as part of its purchase of Forest Oil's Cook Inlet properties in 2007, determined that it would

try to bring a jack-up to the inlet for the open-water season of 2008, to conduct a drilling program in conjunction with Escopeta and Renaissance Alaska, the company that by this time had become operator of the leases at Northern Lights.

But all came to naught in 2009 when Pacific Energy began disposing of its Cook Inlet assets through a Delaware bankruptcy court.

Meantime, frustrated by the lack of progress toward offshore drilling and anxious to encourage exploration of the offshore prospects, Alaska's Division of Oil and Gas started engineering a deal in which existing units and leases at Northern Lights, Corsair and Kitchen would be combined into an expanded single unit called "Kitchen Lights," with Escopeta as operator. Escopeta had farmed in Corsair from Pacific Energy, and Northern Lights from Renaissance and Rutter and Wilbanks.

Texas-based Renaissance Alaska LLC transferred its Northern Lights leases to Escopeta as part of the deal to form the Kitchen Lights unit. But Renaissance also held 10,008 acres in state Cook Inlet offshore leases that covered the company's North Middle Ground Shoal and Northwest Cook Inlet prospects, as well as 47,582 acres on the Kenai Peninsula on its onshore North Sterling and West Eagle prospects.

## Buccaneer Energy

Then, in March 2010, Buccaneer Alaska, a subsidiary of Australian company Buccaneer Energy, entered the Cook Inlet oil and gas business by purchasing all of Renaissance's remaining leases, which by that time had been transferred to a company called Stellar Oil and Gas.

In a May 2010 state areawide lease sale Buccaneer bought additional leases adjacent its lease positions on the Kenai Peninsula and in Cook Inlet, and on land west of Nicolai Creek on the west side of the inlet. The company has also been trying to acquire Cook Inlet Region Inc. and Alaska Mental Health Trust oil and gas leases northeast of the city of Kenai, in hopes of drilling there in 2011. The company plans to permit a 2011 well in the West Eagle prospect, east of Nikolaevsk in the southern Kenai Peninsula, perhaps benefiting from some new gas infrastructure associated with the under-development North Fork gas field. Buccaneer apparently sees the possibility of a 12-well development program at West Eagle. And on the west side of the Cook Inlet, a planned 2011 well at the West Nicolai Creek prospect could lead to a four-well program tied into the nearby Aurora Gas Nicolai Creek field.

Buccaneer has been promoting two of its offshore prospects, Southern Cross (previously called North Middle Ground Shoal) and Northwest Cook Inlet, both of which would need to be drilled from a jack-up rig. The company has described the Southern Cross prospect as a "northward continuation of the Middle Ground Shoal field," while the Northwest Cook Inlet prospect is located north and northeast of the ConocoPhillips-operated North Cook Inlet gas field.

In July 2010 Buccaneer applied to the Alaska Department of Natural Resources to form units at both Southern Cross and Northwest Cook Inlet.

Buccaneer says that it has licensed 51 square miles of seismic data over Southern Cross and plans to drill an initial well in the prospect by Sept. 30, 2012, with the intent of seeking gas in the Tyonek formation and oil in the Hemlock.

Also by Sept. 30, 2012, Buccaneer plans to drill a well in its Northwest Cook Inlet prospect, a gas prospect where the company has about 1,000 miles of 2-D seismic, as well as data from some existing wells on the North Cook Inlet structure.

Buccaneer appears to have been encouraged in its exploration plans by a \$25 million jack-up rig tax credit that the Alaska Legislature passed in the 2010 legislative session. To qualify for the tax credit, a well must penetrate the older Mesozoic rocks of the basin, something that Buccaneer has said that it plans to do when it drills its first well at Southern Cross.

But there's still no sign of a jack-up rig making its way north towards the Cook Inlet.

The plan of exploration for the Kitchen Lights unit, approved in 2009, required Escopeta to have a jack-up rig under contract and on its way to Alaska by June 30 2010, and to have a well drilled in the unit by year end. In May 2010 Davis asked the Alaska Division of Oil and Gas for a 180-day extension to the June deadline, saying that that he was experiencing difficulty in contracting a rig. And on July 19 the division placed Kitchen Lights into default, rather than terminate it, and required Escopeta to have a jack-up rig heading for Alaska by the end February 2011, to drill a well by the end of September 2011. Escopeta also has to pay the state a \$4 million security deposit for Escopeta's cost of moving a rig on a heavy-lift vehicle bound for Alaska.

Apache has made an offer for Escopeta's leases, but so far the

two companies have not come to a deal over this — in June Davis told Petroleum News that the Apache offer was too low but that a deal might still be possible.

## Oil remains exploration target

Although in recent years Cook Inlet basin exploration has tended to focus on natural gas rather than oil, there is still a market for oil, especially for use in Tesoro's Nikiski refinery on the Kenai Peninsula. And there is at least some evidence for renewed oil interest in the region.

Apache has said that the likelihood that significant undiscovered oil resources exist in the basin is the prime driver for its interest in the region; Buccaneer hopes to drill for oil in the Hemlock formation in its offshore Southern Cross prospect; and Armstrong Cook Inlet has expressed an intent to drill for oil below its North Fork gas field in the southern Kenai Peninsula.

Pioneer Natural Resources is investigating the feasibility of developing a known oil accumulation in the Cosmopolitan unit, offshore west of the southern Kenai Peninsula near Anchor Point. The field would be developed from onshore using extended-reach drilling if Pioneer sanctions it. Oil from Cosmopolitan would probably be trucked to Nikiski.

In 2007-08 Pioneer successfully drilled the Hansen 1A-L1 sidetrack well at Cosmopolitan and tested the production of 400 to 500 barrels per day of oil. The drilling also found the potential for some gas production, probably through a 16-mile pipeline that would have to be constructed to connect with the Kenai Kachemak pipeline to the north.

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As a major landowner in Alaska, Cook Inlet Region Inc. has long been a player in the Alaska oil and gas industries, but in recent years the company has been taking steps into energy production, on top of its resource management. The Alaska Native corporation for the Southcentral region, formed by an act of Congress in 1971, owns significant acreage on the Kenai Peninsula and around Beluga Lake on the west side of Cook Inlet. CIRI is involved in several projects to diversify the electricity grid. The company hopes to produce wind energy from Fire Island and hydropower from assets on the Kenai Peninsula. Through its interest in Stone Horn Ridge LLC, CIRI is also pushing ahead on what could be the first underground coal gasification project in Alaska, using a technology that generates synthesis gas from coal deposits too deep to mine. CIRI is also a landowner on several conventional natural gas plays in the region, including Marathon's Sunrise prospect, Chevron's Nikolaevsk unit, Linc Energy's upcoming well near Point



MARGIE BROWN

NAME OF COMPANY: CIRI  
 COMPANY HEADQUARTERS: 2525 C St., Ste 500, Anchorage, AK 99503  
 TOP EXECUTIVE IN ALASKA: Margie Brown, president and CEO  
 MAIN ALASKA TELEPHONE: 907-274-8638  
 ALASKA FAX: 907-279-8836  
 COMPANY WEBSITE: www.ciri.com



MacKenzie and many projects on the west side of the Cook Inlet basin.

**Current exploration focus:**

**Cook Inlet:** As a major landowner in Southcentral, CIRI benefits from several conventional natural gas projects across the Cook Inlet basin. The company is also pursuing renewable and non-traditional forms of energy, from wind on Fire Island, to the Kenai Hydro project, to underground coal gasification with partner Laurus Energy.

Pioneer had planned to drill a second Cosmopolitan delineation well in 2009, but the collapse of oil prices in the wake of the evolving 2008 world economic crisis caused the company to place its drilling plans on hold. However, in January 2010, the company moved forward again on the project by doing a workover and some flow testing on its Hansen sidetrack. And, although Pioneer has not yet decided whether to proceed with development at Cosmopolitan, in April 2010 the company submitted detailed plans for the project to the Alaska Department of Natural Resources and to the U.S Minerals Management Service — those plans indicated possible peak production of 8,000 barrels per day from the field.

**Gas producers look for new resources**

Marathon, ConocoPhillips and Chevron are the main producers of natural gas from the Cook Inlet basin.

For several years Marathon has been carrying out a program

of infield drilling to sustain gas deliverability from its existing gas fields, primarily from the Kenai and Ninilchik fields on the Kenai Peninsula, using its own Glacier 1 rig. However, the company has been evaluating a gas prospect called Sunrise in the northern part of the Kenai Peninsula. Also known as East Swanson, the prospect lies in a Cook Inlet Region Inc. holding inside the Kenai National Wildlife Refuge.

The company acquired some 2-D seismic for the prospect and subsequently completed the Sunrise LK2 well to a vertical depth of 9,798 feet in February 2010. Marathon has not released the results of its drilling.

In 2008 and 2009, following renewal of the export license for the ConocoPhillips and Marathon owned LNG plant on the Kenai Peninsula, ConocoPhillips drilled two new development wells in its offshore North Cook Inlet gas field and three wells in the Beluga River gas field on the west side of the inlet.

Chevron drilled two development wells in the Grayling gas sands on the west side of Cook Inlet in 2008. And on the Kenai Peninsula, Chevron used the Nabors 106E rig to drill a new gas development well in the aging Swanson River field, and to drill two gas development wells in the Happy Valley field.

In 2009 the company drilled two field delineation wells, one in the Ivan River gas field and the other in the Stump Lake gas field, both on the west side of the Cook Inlet.

On the southern Kenai Peninsula, Chevron's exploration efforts in the Nikolaevsk unit are on hold while the company appears a state ruling rejecting a recent plan of development.

In November 2009 Chevron said that it was planning to build a road to the shut-in, single-well Birch Hill gas field, near the Swanson River field in the northern Kenai Peninsula, and to do some testing there in 2010. However, that drilling does not appear to have taken place and in September 2010 Chevron told Petroleum News that it was "still assessing alternatives" for the project.

**Independents explore for gas onshore**

Houston-based Aurora Gas was formed in 2000 to pursue natural gas opportunities in the Cook Inlet region, mainly focusing on known, relatively shallow gas plays. The company operates

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five gas fields on the west side of Cook Inlet: the Kaloa, Lone Creek, Moquawkie, Three Mile Creek and Nicolai Creek fields.

After a nearly two-year hiatus in drilling activity as a result of litigation over a suspended gas supply contract with Enstar Natural Gas Co., the Southcentral Alaska local distribution company, Aurora Gas restarted operations with its AWS-1 rig in the late summer of 2008, subsequently doing some development and workover drilling in its gas fields, including new wells in its Nicolai Creek and Kaloa fields, and a well recompletion in its Moquawkie field.

Aurora Gas has a joint venture agreement with Swift Energy Co. for exploration drilling on Aurora acreage in the Cook Inlet basin. The joint venture drilled a dry wildcat well in the Endeavour oil prospect near Anchor Point on the Kenai Peninsula in 2006. Then, as a result of a change in exploration focus by Swift and a lack of interest by Kaiser Francis Oil Co., Aurora's major owner, in further Cook Inlet exploration drilling, Aurora placed its exploration ideas on hold. However, in 2009 the company found partners to help fund an exploration well at the Hanna prospect on the west side of Cook Inlet, although following a permitting glitch that well was not drilled.

And Aurora has applied to DNR for unitization of some state and Cook Inlet Region Inc. leases around the old Cohoe well northeast of Kasilof on the Kenai Peninsula. Cohoe, originally an oil exploration well, did find evidence of gas in a higher horizon than the oil prospect — Aurora wants to shoot some new 3-D seismic around the prospect and perhaps drill a new gas exploration well.

#### North Fork

In 2008 Armstrong Cook Inlet LLC, the Alaska affiliate of Den-

ver-based Armstrong Oil and Gas Co., successfully drilled a delineation well in a known gas pool in the North Fork unit on the southern Kenai Peninsula. And in November 2009 the Regulatory Commission of Alaska approved a contract for the supply of North Fork gas to gas utility Enstar Natural Gas Co.

The contract requires Enstar to construct a gas pipeline south from the Kenai Kachemak pipeline to Anchor Point, northwest of Homer. Anchor Point Energy, a company owned by the five working interest owners of the North Fork unit, has committed to build a pipeline west from North Fork to connect with the new Enstar line, and to drill two new gas wells at North Fork.

Armstrong, the operator of the North Fork field, has permitted the two new wells and has also expressed an intent to drill deep with one of those wells, looking for oil in the Hemlock formation.

Permitting of the pipeline from North Fork has been moving ahead, with the intent of bringing the field on line in March 2011. The pipeline will open a gas supply for residents of the small Anchor Point community, as well as connecting a new gas source to Southcentral Alaska gas infrastructure and perhaps providing a market outlet for associated gas from Pioneer's Cosmopolitan oil field, offshore Anchor Point. And the State of Alaska is funding the construction of a gas pressure station unit and a short pipeline near Anchor Point, as the first step towards a gas supply for the town of Homer about 12 miles away.

The new pipelines connecting to North Fork will also open up the possibility of developing other gas prospects in the southern Kenai Peninsula.

In March 2010 Australian independent Linc Energy entered

*continued on next page*

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Apache is the biggest newcomer to Cook Inlet in many decades. The large Houston-based independent arrived in July 2010, acquiring nearly 200,000 acres in the Cook Inlet basin from Daniel K. Donkel and Samuel H. Cade, and other individual investors. That may have surprised industry watchers worldwide, who expected Apache to buy some or all of BP's assets on the North Slope. In Alaska, though, the rumors said Apache would bid for Cook Inlet acreage. Apache has since acknowledged that it approached several other players in addition to Donkel and Cade, and said it wants to acquire more acreage.



STEVEN FARRIS

Although Apache acknowledges the natural gas market in Southcentral, where reserves remain undeveloped and local utilities need supplies, the company is focused on oil, and found the Cook Inlet interesting in part because it believes there is untapped potential in the region where oil was first discovered in commercial quantities in Alaska, before the discovery of Prudhoe Bay. Although Apache doesn't have immediate plans to open an Alaska office yet, the company said it doesn't dilly-dally. It plans to acquire more

the Alaska oil and gas industry when it purchased the Cook Inlet basin leases owned by GeoPetro, a lease holding amounting to 122,000 acres spread over two onshore blocks on either side of the northern end of Cook Inlet.

Linc is moving forward on a project started by GeoPetro to drill a gas exploration well, the Frontier Spirit No. 1, to test a gas prospect in the middle and lower Tyonek formations, at a depth of about 8,000 feet in an 11,500-acre structure near Point MacKenzie, a few miles northwest of Anchorage. GeoPetro, having reprocessed some old 2-D seismic, had identified a target that the company thought might hold as much as 1 trillion cubic feet of natural gas.

**Most exploration in upper Cook Inlet Tertiary**

There are two major sequences of hydrocarbon-bearing

NAME OF COMPANY: Apache Corp.  
 HEADQUARTERS OF PARENT COMPANY:  
 2000 Post Oak Blvd., Ste. 100 Houston, TX 77056-4400  
 COMPANY EXECUTIVE OFFICER:  
 G. Steven Farris, chairman and CEO  
 MAIN COMPANY TELEPHONE: 713-296-6000  
 COMPANY WEBSITE: www.apachecorp.com



acreage, shoot 3-D seismic in 2011 and possibly drill as early as 2012. Having earned nearly \$9 billion in revenue in 2009, Apache can afford to drill where it wants.

**Current exploration focus:**

**Cook Inlet:** Apache's initial lease acquisition is spread across the entire Cook Inlet basin, as far north as Wasilla and as far south as Anchor Point, with onshore and offshore blocks on both the west side and east side of the inlet. Apache is an oil-focused company, but acknowledged the local natural gas market. Apache is focused on the Tyonek and Hemlock formations, and believes it can conduct most of its exploration work from land.

rocks in the Cook Inlet basin: a younger and shallower sequence that is Tertiary in age, and an older and often deeper sequence that is Mesozoic in age. And the basin is generally divided into two major regions: the upper Cook Inlet basin north of the southern end of the Kenai Peninsula and the lower Cook Inlet basin extending southwest from the southern limit of the upper basin.

The upper Cook Inlet basin has been the prime focus of oil and gas exploration and is the only part of the basin with producing oil and gas fields.

This part of the basin attains its greatest depth near the northwest corner of the Kenai Peninsula. In that area about 25,000 feet of Tertiary, coal-bearing, terrestrial sediments overlie a thick sequence of marine Mesozoic sediments. The rocks in-

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Cook Inlet Energy rose from the ashes of Pacific Energy. When California independent Pacific Energy filed for bankruptcy in 2009, several of its executives started Cook Inlet Energy to buy the assets. Cook Inlet Energy is now a subsidiary of Tennessee-based independent Miller Petroleum. After months of court proceedings, Cook Inlet Energy closed the deal in December 2009 and shifted gears, becoming a producer in early 2010.



DAVID HALL

Through the sale, Cook Inlet Energy acquired several properties on the west side of the Cook Inlet basin: the West McArthur River unit, the West Foreland natural gas field, the Redoubt unit and Osprey offshore platform, the Kustatan production facility and a 30 percent stake in the Three Mile Creek unit operated by Aurora Gas. The company also got significant exploration acreage, including the Susitna Basin Exploration License, which has not yet been formally transferred and which expires in November. (Miller Petroleum said it plans to ask for an extension.)

In 2010, Cook Inlet Energy brought three wells online at West McArthur River and currently produces some 1,100 barrels of oil equivalent per day. The company also restarted the KF-1 well, shut-in for a year, at the Kustatan facilities, producing 70,000 cubic feet of natural gas per day in a flow test. That gas will be used to fuel

clude an abundance of hydrocarbon sources, reservoirs and traps.

A broadly similar sequence of Tertiary rocks extends across the whole upper Cook Inlet area, but thins toward the edges of the basin and toward the lower basin.

Oil exploration in the area initially targeted the Mesozoic strata but the 1957 discovery of the Swanson River oil field in Tertiary sediments shifted the attention of subsequent exploration to the Tertiary. To date there have been 11 significant oil finds and 28 significant gas finds in the upper Cook Inlet area, with all of the finds occurring in the Tertiary — all of the oil and gas produced in Southcentral Alaska comes from these fields.

### Major geologic trends

And because the geologic stresses that have operated during the evolution of the basin have tended to fold and fracture the rock strata along a northeast-to-southwest trend, the oil and gas fields in the basin tend to line up along that trend, following the crests of large geologic structures.

The largest oil field in upper Cook Inlet, the McArthur River field, had produced 628 million barrels of oil by the end of 2008, with ultimate recoverable oil reserves of about 646 million barrels, according to data published by Alaska's Division of Oil and Gas. The largest gas field, the Kenai field, had produced 2.355 trillion cubic feet of gas with ultimate recoverable reserves of about 2.458 tcf.

Although the reservoirs of the Cook Inlet oil and gas fields lie within Tertiary rocks, petroleum geologists have determined that most of the oil actually originated from source rocks in the Mesozoic, in what geologists refer to as the middle Jurassic. On the other hand, although some gas would have been generated by thermal processes from Jurassic source rocks along with the oil, most of the gas originated by itself from bacterial processes in coal-rich Tertiary sediments.

**NAME OF COMPANY:**  
Cook Inlet Energy LLC  
**HEADQUARTERS OF COMPANY:** 601 West 5th Avenue, Ste. 310, Anchorage, AK 99501  
**TOP EXECUTIVE:** David Hall, CEO  
**MAIN ALASKA TELEPHONE:** 907-433-3804  
**MAIN ALASKA FAX:** 907-258-8601



field operations. The company plans to drill five wells at West McArthur River over the coming year and believes the expansion could add more than 2,000 barrels of oil to its daily production profile, but still needs to raise capital before undertaking the effort.

Cook Inlet Energy holds more than 75,000 acres in state leases, plus nearly 18,000 leases picked up in a May 2010 sale. The company also holds partial interest in some 52,000 acres and is the owner of a 471,474-acre exploration license in the Susitna basin.

### Current exploration focus:

**Cook Inlet:** Cook Inlet Energy is focused on developing onshore oil and gas assets on the west side of the Cook Inlet basin, particularly the West McArthur River unit.

Cook Inlet exploration has mainly targeted large structures in the Tertiary, and some undiscovered oil accumulations probably remain in this type of setting. However, some geologists believe that substantial quantities of oil lie within Mesozoic reservoirs. But, given the expense and relative risk of deep drilling, very few wells have targeted this Mesozoic play.

In legislation passed in 2010, the State of Alaska now offers up to \$67.5 million in tax credits for wells drilled from a Cook Inlet jack-up rig into the Mesozoic. The first company to drill a well of this type will receive a credit of 100 percent of costs, up to \$25 million; the second 90 percent, up to \$22.5 million; the third 80 percent, up to \$20 million.

A 2004 study by the U.S. Department of Energy has also pointed out that the exploration of large oil-bearing structural traps has probably left undiscovered many gas accumulations in the Cook Inlet basin. From a statistical analysis of the known gas accumulations, DOE has estimated that there may be as much as 10 tcf to 14 tcf of undiscovered natural gas in the Tertiary of the upper Cook Inlet area. DOE believes that much of this undiscovered gas lies in the stratigraphic and combination traps that people exploring for oil largely ignored.

### Focus on subtle gas plays

With the exception of some undeveloped offshore prospects, exploration for new hydrocarbon accumulations has tended to move away from the big structures, many of which have been drilled and produced. Attention is now starting to focus on subtle, off-structure plays that may contain some of the huge quantities of Tertiary gas thought to still exist in the Cook Inlet basin.

The poor quality of the seismic data for the Cook Inlet area has become an issue when searching for these subtle stratigraphic plays. The thick Tertiary section contains many coal seams and exhibits big density contrasts. This type of geology dissipates seismic energy and gives poor seismic reflections. It

has even proven difficult to apply modern 3-D seismic techniques for delineating stratigraphic traps.

Considerable effort is now going into gaining a better understanding of how best to use 3-D techniques in the Cook Inlet geological situation, especially in the deeper parts of the section. And Alaska's Division of Geological and Geophysical Surveys is engaged in a multiyear Cook Inlet basin research project, with the geology of stratigraphic traps as a major focus.

The difficulty in interpreting seismic data, the need to search for subtle traps and uncertainties about the lateral continuity of subsurface rock strata make Cook Inlet a challenging area to explore — problems with reserve estimation in the Redoubt Shoal field have illustrated some of the risks in reservoir assessment with less than complete subsurface information.

In addition, onshore land access can prove complex because of a multiplicity of land ownership arrangements. However, companies are managing to handle the complexities of dealing with geology that doesn't always line up with land ownership boundaries. On the other hand, the Kenai National Wildlife Refuge does limit exploration access to substantial areas of land on the Kenai Peninsula.

### The Susitna basin

Much of the broad area of lowland stretching north from the northeast end of Cook Inlet and crossed by the Susitna River and its various tributaries, as well as by lesser waterways, lies over another basin, referred to by geologists as the Susitna basin and forming what some consider to be a northern extension of the Cook Inlet basin. A major geologic fault, the same fault that delineates the northwest side of the Cook Inlet basin, divides the two basins.

Tertiary rocks, many corresponding to similar rocks in the Cook Inlet basin, occupy the Susitna basin, but the oil-prone Mesozoic source rocks of the Cook Inlet basin have not been found in wells or outcrops in the Susitna Valley.

Seismic data from the Susitna basin have revealed geologic structures dominated by faulting rather than folding, where vertical displacements of blocks of the older rocks that underlie the basin have dislocated the younger Tertiary rocks above.

Nine oil and gas exploration wells and four core holes have been drilled in the Susitna basin. All exploration wells were plugged and abandoned as dry holes, though some did have minor gas shows. The two wells drilled near the deepest part of the basin were the Union Texas Pure Kahiltna Unit No. 1, completed in March 1964 to a total depth of 7,265 feet, and the Unocal Trail Ridge Unit No. 1, completed in October 1980 to 13,708 feet. Coal beds become prominent in the lower part of both of these wells, suggesting a correlation with the coal-bearing, gas-producing formations in the Cook Inlet basin.

### Coalbed methane

The prevalence of coal seams in the Tertiary rocks around the Cook Inlet and Susitna basins gives rise to a major resource potential from coalbed methane.

But exploration for coalbed methane in Southcentral Alaska has proved controversial because of issues surrounding split estate land ownership between the State of Alaska and private landowners, and because of worries by local residents about environmental issues, especially ground-water contamination. However, the increasing demand for new gas sources together with new coalbed methane production technologies involving

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the use of horizontal drilling, coupled with improved guidelines for coalbed methane exploration and development, may lead to successful commercialization of this resource.

Aurora Gas has expressed an interest in testing the development of coalbed methane from coal seams above its Moquawkie gas field in a remote area on the west side of the Cook Inlet.

### Underground coal gasification

In October 2009 Cook Inlet Region Inc. announced plans to develop a 100-megawatt power plant fueled by gas generated by the underground gasification of coal seams in CIRI land in the Beluga area on the west side of the Cook Inlet.

Underground coal gasification, or UCG, involves the pumping of compressed air into a coal seam deep underground to enable the controlled underground combustion of some coal; the heat from the burning converts excess air and the bulk of the coal to synthetic gas for delivery to the surface through production wells. Under CIRI's plan, carbon dioxide in the gas would be stripped out for enhanced oil recovery from Cook Inlet oil fields, while the remaining combustible components of the gas would provide a valuable replacement for tightening supplies of Cook Inlet natural gas, as a power generation feedstock.

In June 2010 CIRI announced the formation of a joint venture with Houston-based Laurus Energy to build the UCG facility.

Also in June 2010, the Alaska Mental Health Trust Lands Office announced that it would offer 190,000 onshore acres spread across the Denali Borough, the northern and western Cook Inlet basin and the northern Kenai Peninsula for licensing to exploration companies interested in producing natural gas through the gasification of deep coal deposits. And in August

2010 the Alaska Oil and Gas Conservation Commission formally took over authority to regulate wells drilled for UCG exploration.

Linc Energy, the newcomer to the Alaska oil and gas industry that is planning to drill a conventional gas exploration well near Point Mackenzie in the northern part of the Cook Inlet basin, specializes in underground coal gasification. The company has said that it believes that large quantities of coal suitable for gasification lie under its oil and gas leases but it has not indicated any plans to pursue a coal gasification project in Alaska.

## Cook Inlet region offers opportunity and challenge

Nearly all of the oil and gas fields in Cook Inlet derive from exploration done in the 1950s and 1960s, before the discovery of the giant Prudhoe Bay field caused the attention of explorers to switch to the North Slope. As a consequence, only limited exploration of Cook Inlet has taken place in more recent decades.

Although past exploration in the region focused primarily on finding oil, large volumes of gas were also encountered during that drilling effort. A resulting excess supply of stranded natural gas drove the construction of LNG and fertilizer plants at Nikiski on the Kenai Peninsula and has enabled the residents of highly populated Southcentral Alaska to enjoy cheap gas for heating and electricity generation.

In recent years, as production from old oil and gas fields has declined, demand for gas has started to come into balance with supply, while the price of gas in Southcentral Alaska has begun to rise, thus heightening new interest in gas exploration in the Cook Inlet



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► MSI Communications President Laurie Fagnani has overseen numerous successful campaigns, including the defeat of the gas reserves tax initiative and the anti-mining initiative.

Aurora Gas was formed in 2000 to pursue natural gas opportunities in the Cook Inlet basin. Within five years, the company became the operator of five fields on the west side of the Cook Inlet basin: Albert Kaloa, Lone Creek, Moquawkie, Nicolai Creek and Three Mile Creek. Since 2005, Aurora's fortunes have shifted both for better and for worse. The company discovered gas with an exploration well at Three Mile Creek, but hit a dry hole with its next wildcat, Aspen No. 1. A joint venture with Swift Energy in 2006 led to an unsuccessful well. A legal battle with Enstar over a contract dispute led Aurora to suspend drilling operations for more than a year. Aurora resumed drilling operations in mid-2008, re-entering the Aspen dry hole, recompleting Three Mile Creek No. 2, and drilling Moquawkie No. 4, which experienced a blowout that the company got under control in less than 24 hours. In 2009, Aurora drilled the Kaloa No. 3 well, a dry hole.

This year, Aurora focused on the Nicolai Creek unit, bringing the NCU No. 11 well online and planning an NCU No. 10 well. In 2011, Aurora plans to use the existing NCU No. 2 wellbore to inject up to 1 billion cubic feet of natural gas into a nearly depleted reservoir for third-party storage, and wants to eventually drill another, horizontal well into the storage sands. That plan passed legislative and regulatory hurdles this year, but Aurora is still in negotiations with the Alaska Department of Natural Resources over a storage lease. In



SCOTT PFOFF

JUDY PATRICK

## NAME OF COMPANY:

Aurora Gas

## HEADQUARTERS

OF PARENT COMPANY: Houston, Texas

CHIEF EXECUTIVE OFFICER: Scott G. Pfoff, President and CEO

HEADQUARTERS IN ALASKA: 1400 W. Benson Blvd., Ste.410, Anchorage, AK 99503

ALASKA PHONE: 907-277-1003

ALASKA FAX: 907-277-1006

COMPANY WEBSITE: www.aurorapower.com



2010, Aurora also recompleted and tested Moquawkie No. 4, and applied to form the Cohoe unit over leases southwest of Soldotna, promising to shoot 3-D seismic and re-enter the Cohoe No. 1 well in order to keep several leases from expiring.

Aurora produced some 2.1 billion cubic feet of gas in Alaska in 2007. The company currently leases more than 25,000 acres of state land across the Cook Inlet basin.

**Current exploration focus:**

**Cook Inlet:** Aurora is developing the Nicolai Creek unit on the west side of Cook Inlet, where it also plans to start third-party storage. The company is also minding existing wells across its acreage, including the Moquawkie unit and the proposed Cohoe unit.

basin.

In 2008 the U.S. Department of Energy granted a two-year extension to the export license for the LNG plant from 2009 to 2011. And the owners of the LNG facility (Marathon and ConocoPhillips) agreed to do some new Cook Inlet gas drilling as part of a deal with the State of Alaska that ensured state support for the license extension.

In June 2010 the facility owners asked DOE for a two-year extension to the license, an extension that would run through to March 31, 2013. The owners said that the license extension would enable them to export the remainder of the gas that had been approved in 2008 for export and that no additional volumes of gas were involved. The reduction of the LNG carrier fleet serving the facility from two vessels to one had slowed the rate of LNG export, thus making it impossible to export by 2011 the complete volume of gas approved in the current license, the owners said.

At the time of going to press, DOE had not issued a decision on the license extension request.

Agrium, the owner of the Nikiski fertilizer plant, closed the plant in 2007 because of a lack of adequate gas supplies at viable prices. Agrium investigated coal as an alternative feedstock to natural gas for fertilizer production, but said in March 2008 it had determined that its proposed coal gasification facility to supply syngas for the plant was not economic. However, new gas discoveries in Southcentral Alaska or gas from a possible future gas pipeline carrying North Slope gas to the Kenai Peninsula might result in the fertilizer plant being reopened, Agrium has said.

**Industrial underpinning**

Industrial facilities such as the Nikiski LNG plant underpin the Cook Inlet gas industry by providing a large and relatively stable

**Exploration licenses open Susitna**

Very little oil and gas exploration has been done in the Susitna basin, the northern extension of the Cook Inlet basin in the valley of the Susitna River. A total of nine exploration wells and four core holes have been drilled in the basin, with all wells subsequently plugged and abandoned as dry holes, although some did have minor gas shows.

In 2003 the state issued three exploration licenses for the Susitna basin — an exploration license enables a company to explore in a region that is not an established oil and gas province without buying oil and gas leases. Susitna license 1, covering 408,060 acres west of Talkeetna and the Parks Highway, was issued to Forest Oil but was terminated in 2007. Susitna license 2, to the south of license 1, was issued to Pacific Energy which has since gone bankrupt. License 3, to the west of licenses 1 and 2, was offered to Clearflame Resources but the company did not take the license up.

In 2008 LAPP Resources, an Anchorage exploration company owned by David Lappi, a longtime Alaskan and energy entrepreneur, applied for an exploration license covering about 21,080 acres near Houston and Willow in the Susitna Valley, but that exploration license has not been issued.

In May 2010 Alaska's Division of Oil and Gas said that it was evaluating a new proposal for exploration in the Susitna license 1 area, but the division declined to name the company involved.

*continued on next page*



Buccaneer Alaska clearly aligns itself with the school of thought that believes the Cook Inlet basin is underexplored. The Australian independent arrived in Alaska in March 2010, buying up leases from fellow independent Stellar Oil and Gas. Over the spring and summer, Buccaneer grew its land position in lease sales and private deals, and now the company is listed as having nearly, 75,197 acres of onshore and offshore state leases.



JAMES WATT

Buccaneer aims to do something with that land, and soon. In August, the company applied to form two offshore units. The company is also progressing three other prospects on its onshore lease holdings. Buccaneer is steadily moving forward on all five prospects, saying it will spend 2010 acquiring seismic and permitting wells, in preparation for drilling no later than 2012 and developing as early as 2015. If the company can get an offshore program together fast enough, it could be eligible for new tax credits available to the first three companies to use a jack-up rig in Cook Inlet.



MARK LANDT

**Current exploration focus:**

**Cook Inlet:** Buccaneer is progressing five prospects.

The proposed Southern Cross Unit, formerly known as North Middle Ground Shoal, would include five leases over some 10,109 offshore acres west of the Kitchen Lights unit. Buccaneer plans to drill to an exploration target in the Jurassic, and delineate natural gas and oil in the Tyonek and oil in the Hemlock formations. Activities are underway to complete an initial well in 2011. The proposed

market for the gas. And, as part of the state's deal with the LNG plant owners at the time of the LNG export license renewal, the owners agreed to allow gas producers other than themselves to supply some of the gas used by the plant.

Local gas and power utilities are the other main purchasers of Cook Inlet natural gas. But these utilities constitute quite a small market, with a gas demand that fluctuates widely between warm summer days when gas usage is relatively low, to frigid winter conditions when gas usage, especially for space heating, soars.

The LNG plant provides an invaluable service by curtailing liquefaction of export gas during severe winter cold, to enable gas producers to meet the exceptionally high gas deliverability requirements of the utilities. And, also to bolster winter gas deliverability, Marathon and Chevron operate gas storage facilities that use depleted gas reservoirs to store excess gas produced in the summer for later use during the winter.

**New gas storage**

Cook Inlet Natural Gas Storage Alaska has embarked on a project to build a gas storage facility, using depleted gas sands in the Cannery Loop field on the south side of the city of Kenai. This facility, with operation planned to start in the summer of 2012 to head off anticipated gas deliverability shortfalls in the following winter, still requires Regulatory Commission of Alaska approval but would provide storage services to third-party businesses. Utilities Enstar Natural Gas Co., Chugach Electric Association and Municipal Light & Power would be initial customers.

CINGSA is a joint venture between MidAmerican Energy Holdings Co. and Semco Energy, the parent company of Enstar.

Aurora Gas has also proposed developing a gas storage facility

NAME OF COMPANY: Buccaneer Alaska, LLC  
 CHIEF EXECUTIVE OFFICER OR OFFICERS IN OR OUT OF ALASKA: James S. Watt, President & COO; Mark R. Landt, Vice President Land & Business Development; W. Allen Huckabay, Vice President Exploration & Development; E. Andrew Rike, Jr., Operations Manager  
 MAIN PHONE NUMBER: 281-768-7650  
 MAIN FAX: 281-768-7700  
 HEADQUARTERS OF PARENT COMPANY: Buccaneer Energy Limited located in Sydney, Australia  
 HEADQUARTERS TELEPHONE: +61 2 9233 2520  
 COMPANY WEBSITE: www.buccenergy.com



Northwest Cook Inlet Unit would cover six leases over some 10,008 offshore acres contiguous to ConocoPhillips' North Cook Inlet unit. Buccaneer plans to target natural gas in the Beluga sands with an initial well drilled by 2012. The onshore West Eagle prospect in the southern Kenai Peninsula, east of Nikolaevsk, could benefit from new natural gas transportation infrastructure going into the region. Buccaneer plans to permit a well for late 2011 that could lead to a 12-well development program. The onshore West Nicolai Creek prospect could tie back to the nearby Nicolai Creek unit. Buccaneer plans to permit a well for 2011 that could lead to a four-well program.

Finally, if Buccaneer successfully leases Alaska Mental Health Trust and Cook Inlet Region Inc. land northeast of Kenai, it plans to drill an onshore well there in late this year or early 2011.

for third-party use in a depleted reservoir in the company's Nicolai Creek gas field on the west side of the Cook Inlet — in August 2009 the company held an open season, to test the potential market for this facility and is in the process of negotiating a gas storage lease with the Alaska Department of Natural Resources.

In addition to alleviating winter gas deliverability shortfalls, third-party storage facilities of the type that CINGSA and Aurora hope to build could provide new market outlets for independent gas producers wishing to sell gas to Southcentral Alaska utilities.

**Gas badly needed**

And new natural gas production from Cook Inlet is badly needed, given the dependence of Southcentral Alaska residents and businesses on gas for heating and power. Despite assuming the cessation of exports from the LNG plant after 2011 and despite also assuming the continued development of existing gas fields, projections of total Cook Inlet gas production show a shortfall relative to utility demand after 2019, Kevin Banks, director of Alaska's Division of Oil and Gas, told the Alaska House Special Committee on Energy in March 2009.

A report prepared by division scientists and published in late 2009 indicated that current Cook Inlet gas reserves might meet supply needs until around 2015, but that development drilling to establish fairly certain new reserves around existing fields could delay the gas shortfall to nearly 2020. The development of less certain new reserves might further delay the shortfall to somewhere between 2020 and 2025.

A study conducted by Petrotechnical Resources of Alaska for utilities Enstar Natural Gas Co., Chugach Electric Association and Municipal Light & Power and published in March 2010 looked at

Escopeta came by the largest unit in the Cook Inlet basin the hard way. The Houston-based independent first took interest in Alaska in the early 1990s and began accumulating Cook Inlet leases by the end of the decade. In 2003, the company began focusing on the Kitchen and East Kitchen prospects, but couldn't line up the pieces needed for a drilling program in shallow, sub-Arctic waters. Those challenges have continued in the seven years since. The state merged Kitchen with two other offshore units in 2009, making Escopeta the operator of the 83,394-acre Kitchen Lights unit. The state recently put the unit in default, but also gave Escopeta more time to finally bring a jack-up rig to Cook Inlet. Escopeta recently appealed the default decision. Making the task somewhat easier, though, is a significant new tax credit that will defray the cost of the first three Cook Inlet wells drilled by a jack-up rig. Success for Escopeta at Kitchen Lights could temper declining



DANNY DAVIS

NAME OF COMPANY:  
Escopeta Oil & Gas  
HEADQUARTERS:

Houston, Texas

CHIEF EXECUTIVE OFFICER:

Danny Davis, president and CEO

ALASKA OFFICE: none

TELEPHONE: (713) 623-2219 • WEBSITE: www.escopeta.biz



natural gas production in the Cook Inlet, but failure could mean the end of the company in Alaska; Escopeta recently relinquished its North Alexander prospect.

**Current exploration focus:**

**Cook Inlet:** Escopeta needs to have a jack-up rig on a ship bound for Alaska by February 2011 and start drilling a well by September 2011, or risk losing the Kitchen Lights unit.

the economics of developing new Cook Inlet gas reserves. This study concluded that the maintenance of adequate Cook Inlet gas supplies though developments around existing fields would require the drilling of more and more wells each year, with a total of 185 new wells at a total cost of \$1.9 billion to \$2.8 billion needed to maintain supplies through to 2020. In the absence of a successful near-term drilling program, utility gas supplies will start to fall short in 2013, the report says.

Meantime winter gas deliverability has become especially tight: On Jan. 3, 2009, Enstar Natural Gas Co., the main Southcentral

Alaska gas utility, hit a peak daily throughput of 314.5 million cubic feet, causing the LNG plant to reduce its daily gas consumption to just 40 million cubic feet, a volume that Enstar said was close to the lower limit for the plant.

**Market challenges**

But some significant market challenges face an explorer wishing to find and produce new Cook Inlet natural gas reserves.

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Not all resource drilling in Alaska is for oil or natural gas. Ormat Nevada, a subsidiary of Reno-based Ormat Technologies Inc., is planning to drill wells to measure the geothermal potential around Mount Spurr, west of Tyonek. After 15 years of scoping out the state, Ormat arrived in Alaska in September 2008, picking up 15 tracts in a state geothermal lease sale, the first since 1986. Ormat bills itself as the only vertically integrated geothermal company in the world, building its own equipment and operating more than 4,000 megawatts of geothermal power, mostly in Nevada, California and Hawaii.



RAHM ORENSTEIN

This past summer, Ormat began a field program in Alaska, conducting geophysical surveys over its leases to find the best drilling sites. In August, the company proposed a four well program. These slim holes, less than 4 inches in diameter, measure underground temperatures and collect information about subsurface rocks in the area, information Ormat will use to decide whether to move ahead on geothermal development. If Ormat eventually sanctions a project, it would only need some 40 miles of transmission lines to connect into the westernmost point of the existing grid in Beluga. That could add significant geothermal power to the Southcentral power grid, reducing natural gas use.

In the first place, with virtually all existing utility gas supplies tied up in medium- and long-term contracts between the utilities and a relatively small number of established gas producers, it is very difficult for a new market entrant to find a sufficient market to render a new gas field viable. There is no effective spot market for gas in Southcentral Alaska.

And then, in the absence of a spot market, there is the tricky question of pricing the gas. Because the gas price forms the dominant component of the price that Southcentral Alaska consumers pay for energy, and because regulated utilities supply that energy, the Regulatory Commission of Alaska, the state's regulating agency, in effect regulates Cook Inlet basin utility gas prices. A series of challenges to pricing in new utility gas supply contracts in recent years resulted in what one RCA commissioner characterized as "the Cook Inlet Gas War."

However, although a lively debate continues about appropriate pricing for Cook Inlet natural gas, RCA's 2009 approval of two utility gas supply contracts, followed by the commission's approval in 2010 of two further contracts, gives rise to hope that there is at least some form of truce in the gas contract combat zone.

## Geology of Cook Inlet region

The surface topography of volcanoes, mountain ranges, flatlands and sea passages around the Cook Inlet area provides dramatic evidence of the way in which major pieces of the Earth's crust, known as plates, move around the Earth's surface, tossing up mountain ranges in places and dragging down deep basins in others.

One of the plates, the Pacific plate, slides north along the California and Pacific Northwest coastlines before slipping beneath another plate, known as the North American plate, along a zone marked by the Aleutian trench, south and east of Kodiak Island and the Alaska Peninsula. The massive forces unleashed by this

COMPANY NAME: Ormat  
 HEADQUARTERS OF PARENT COMPANY: Reno, Nevada  
 CHIEF EXECUTIVE OFFICER OF PARENT COMPANY: Dita Bronicki, Chief Executive Officer, Director  
 TOP EXECUTIVE IN ALASKA: Rahm Orenstein, Director of Business Development  
 MAIN ALASKA TELEPHONE NUMBER: 775-356-0174  
 ALASKA FAX: 775-823-5401  
 COMPANY WEBSITE: www.ormat.com



Ormat got a lift in April when the Legislature passed a bill to reduce royalty rates for geothermal power. In September, the company got two drilling permits from the Alaska Oil and Gas Conservation Commission. Under good circumstances, Ormat said it could drill all four slim holes within 30 days, but inclement weather could delay some drilling until next year. The company holds some 35,800 acres of state geothermal leases.

### Current exploration focus:

**Cook Inlet:** Ormat Nevada is drilling "slim holes" near Mount Spurr on the western side of the Cook Inlet basin to gather information for geothermal development in the region.

## Lower Cook Inlet risk, potential

The lower Cook Inlet basin contains as much as 36,000 feet of marine Mesozoic strata. But in this area the Tertiary sequence that contains the oil and gas reservoirs in the upper Cook Inlet becomes very thin.

According to a 1995 MMS assessment, the Mesozoic of the lower Cook Inlet includes some potentially excellent oil source rocks. The middle Jurassic strata include the same source rocks as those that generated oil in the upper Cook Inlet.

The MMS assessment also says that there are some Mesozoic sandstones that have good reservoir potential.

But the chemical alteration and resulting reservoir degradation of some of the Mesozoic sandstones has cast something of a pall over prospects of finding viable hydrocarbon pools in these rocks, thus upping the ante on exploration risks, even although the regional distribution of the reservoir clogging alteration is not fully understood and some of the rocks may contain fracture systems that would allow fluids to flow.

To date, 11 exploration wells have been drilled in the offshore waters of the lower Cook Inlet. Two of the wells found significant oil shows but the oil finds proved uneconomic. Another well only found minor oil shows.

tanic struggle between two of the larger pieces of the Earth's crust have uplifted a chain of coastal mountain ranges, including the Chugach and Kenai mountains, while heat generated deep underground has caused lava and ash to spew up through an arc of volcanoes, known as the Aleutian archipelago. And as the Pacific plate has slid downward beneath the Earth's surface it has dragged down an elongated section of the North American plate to form the Cook Inlet basin.

## Two rock sequences

There are two major sequences of hydrocarbon-bearing rocks in the basin.

The events that led to the formation of the first of these sequences began around 350 million years ago, when a volcanic arc in the general vicinity of the present-day Alaska Range poured lava and volcanic materials into adjacent areas. Then, around 240 million years ago, uplift of the area occupied by the volcanic arc started tipping sediments south into a marine basin in the area of the current Cook Inlet. As this basin slowly subsided beneath an ancient sea, many thousands of feet of stratified marine sediments, some rich in organic material, accumulated.

These older and deeper strata of the Cook Inlet basin are referred to as the Mesozoic.

Uplift of the land around 70 million years ago started to form the Kenai and Chugach mountain ranges. Erosion of the mountains then dumped sediments into a Cook Inlet basin that was by then above sea level. Deposition of river-borne sand and gravel alternated with luxuriant swamp vegetation growth. Through this repetitive cycle of vegetative growth and sediment deposition, peat layers were developed and buried, producing present-day

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*The present day Cook Inlet basin sits between two northeast- southwest trending geologic faults that form massive fractures in the Earth's crust, where the rock strata inside the basin have sunk and tipped inward.*

---

coal formations. The nonmarine sands and gravels would later become oil and gas reservoirs in what is referred to as the Tertiary section.

Uplift, accompanied by deformation and fracturing of the rocks, continues today, thus making Cook Inlet a seismically active region. As a result of a massive earthquake in March 1964, most of the western Gulf of Alaska including Prince William Sound was uplifted while the entire Cook Inlet basin from the Talkeetna Mountains to Kodiak Island sank. Areas of active volcanism still exist and are considered to have high geothermal potential.

### Fault bounded

The present day Cook Inlet basin sits between two northeast- southwest trending geologic faults that form massive fractures in the Earth's crust, where the rock strata inside the basin have sunk and

tipped inward. One fault runs along the northwest side of the Kenai Mountains, while the other fault runs parallel to the northern Cook Inlet shoreline a few miles onshore.

An area of uplifted rock known as the Augustine-Seldovia arch, under Cook Inlet west of the southern tip of the Kenai Peninsula, divides the upper Cook Inlet basin from the lower Cook Inlet basin. The Mesozoic section contains oil-prone source rocks, including known oil sources in what geologists refer to as the middle Jurassic Tuxedni Group. The Tertiary section contains abundant coal seams and other organic-rich sediments that form a source of gas formed by bacterial action, rather like methane bubbling from a dung heap.

Both the Mesozoic and the Tertiary contain potential oil and gas reservoir rocks, although in the Mesozoic strata rock compaction combined with various forms of chemical and thermal alteration may have degraded the reservoir quality. Many sands in the Tertiary strata have excellent reservoir characteristics, although the way in which these sands were deposited from rivers and lakes has tended to result in reservoirs divided into many thin, lens-shaped compartments.



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The Arctic Wolf No. 2 drilling rig on site near Nenana in July 2009, ready to drill the Nunivak No. 1 exploration well.



## Interior Alaska basins

By Alan Bailey  
Petroleum News Senior Staff Writer

**A**lthough analysts think that the majority of Alaska's oil and gas resources lie within the major basins of northern Alaska, Cook Inlet and the Bristol Bay area, there are several other basins around the state that have attracted the attention of oil and gas explorers.

These basins typically consist of huge faulted blocks that have sunk, as forces deep within the Earth have bent and stretched the Alaska landmass during the past 60 million years or so. The deepening inland basins have progressively filled with an accumulation of river-borne sand, gravel and pebbles, interspersed with finer-grained material deposited in freshwater lakes, and often with coal seams that mark periods of luxuriant vegetation growth. These assemblages of terrestrial sediments are typically Tertiary in age.

Although some rock samples from the basins contain material conducive to oil formation, the nonmarine rocks in most of the basins contain coal and other material that would more likely favor the production of natural gas.

In Southcentral Alaska and the northern Interior there are also extensive areas of older Mesozoic rocks, typically formed from the detritus of volcanic arcs that were prevalent features of a dominantly marine landscape at the time. These Mesozoic strata sometimes form the lower sections of the Tertiary basins such as the Cook Inlet basin. In the Cook Inlet and Alaska Peninsula regions the Mesozoic strata have formed petroleum systems that are active and obvious, but so far sub-economic; elsewhere in Alaska, with the possible exception of the Copper River Valley, the Mesozoic rocks appear more problematic as exploration targets.

In this section of "Explorers" we review exploration activity in those Interior basins that has attracted recent exploration interest.

## Copper River basin

The Copper River basin sits in a lowland area due north of the Gulf of Alaska and bounded by the Alaska Range, the Wrangell Mountains and the Chugach Mountains. The geology of the basin bears many similarities to that of the Cook Inlet basin, especially in the Mesozoic section — during Mesozoic times the Copper River and Cook Inlet areas formed part of a huge marine region.

The age of the Mesozoic marine sediments around the Copper River Valley ranges from middle Jurassic to late Cretaceous, with a sequence of rocks strikingly similar to the Mesozoic of Cook Inlet. The sequence includes rocks that are age-equivalent to the source rock of most of the oil found in the Cook Inlet oil fields, but they differ somewhat in their composition and are reportedly less oil prone. One Copper River Mesozoic limestone formation exhibits oil stains and petroliferous odors. Coal in one part of the section may have generated natural gas.

The Tertiary section that occupies the basin is typical of rock of that age in Alaska, having terrestrial sediments interspersed with coal seams in a geologic setting conducive to the formation of biogenic gas — gas that has formed from the bacterial decomposition of organic material.

### Limited exploration

Some limited oil and gas exploration of the area was done prior to the mid-1980s, with geophysical surveys and 11 wildcat wells. Several of the wells encountered oil and gas shows. The wells also encountered overpressured zones, especially in a dis-

*continued on page 54*

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Doyon Ltd. is the Alaska Native corporation for the Interior and the largest private landowner in Alaska. In recent years, Doyon has increased exploration efforts on its lands, which are believed to be very prospective for both oil and natural gas.

In a partnership operated by Denver-based Rampart Energy, Doyon drilled the Nunivak No. 1 well near Nenana in July 2009, following up on wells drilled in the gas-prone area southwest of Fairbanks in the 1960s and the 1980s. This newest effort dates to an exploration license purchased in 2002 and a seismic package shot in 2005. A 2006 change to the tax code challenged the project, but another change in 2007 paved the way for drilling. Doyon hasn't released detailed results from the program, but said its exploration activities in Nenana are currently on hold because of uncertainties about the Railbelt energy market — including plans to truck liquefied natural gas to Fairbanks, several in-state pipeline proposals and pending legislation to consolidate regional electric utility assets. Doyon might choose to shoot seismic over the area in 2011-12.

However, Doyon is increasingly interested in its lands in the



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NAME OF COMPANY: Doyon Limited  
 HEADQUARTERS OF PARENT COMPANY:  
 1 Doyon Place, Ste. 300,  
 Fairbanks, Alaska 99701  
 TOP EXECUTIVE IN ALASKA: Norman L.  
 Phillips, Jr., President and CEO  
 MAIN ALASKA TELEPHONE NUMBER:  
 907-459-2000  
 MAIN ALASKA FAX NUMBER: 907-459-2060  
 COMPANY WEBSITE: www.doyon.com



Yukon Flats after gathering geologic and geophysical information in the area. Doyon said it wants to gather and study more data about the region before bringing partners for a broader exploration program.

**Current exploration focus:**

**Interior Alaska:** Doyon recently drilled a well in the Nenana basin, but is putting the program on hold because of market uncertainties in the Railbelt. Doyon is currently gathering geologic and geophysical data over lands it owns in the Yukon Flats area.

tinctive Mesozoic limestone horizon. Mud volcanoes in the Tolsona area emit gas containing a high percentage of methane.

A more recent resurgence of interest in the area resulted in the issue of a State of Alaska exploration license in October 2000 to Anschutz Exploration, on 398,445 acres of state land west of the town of Glennallen. The area of interest also encompassed some Native land owned by Ahtna Inc., the Alaska Native regional corporation for the Copper River Valley.

After the shooting of some 2-D seismic in the exploration area, and following some shuffling of business deals around the funding of exploration activities, Texas-based Rutter and Wilbanks, with Anschutz and Forest Oil as minority partners, spudded a wildcat gas well on Native land in early 2005, in a structure near an Amoco well drilled about 25 years earlier.

The Rutter and Wilbanks well, the Ahtna 1-19, was drilled to

its target depth of 7,500 feet, apparently without finding any gas. But because of a high pressure zone at a depth of 1,200 feet, the company had to use heavy drilling mud that damaged a potential gas reservoir partway down the well.

In October 2005, with the original Glennallen exploration license set to expire, Forest Oil, the company that by then owned the license along with Anschutz, filed a successful application to convert part of the license area to standard state oil and gas leases in the neighborhood of the Native land where Rutter and Wilbanks had drilled the Ahtna 1-19 well. Anschutz and Pacific Energy Resources, the company that bought Forest Oil's Alaska properties in 2007, still own these leases, but Pacific Energy has been trying to dispose of its Alaska assets in bankruptcy court in Delaware.

In the fall of 2006, Rutter and Wilbanks made an unsuccessful attempt to penetrate the damaged section of reservoir rock in the Ahtna 1-19 well, using a Cad Pressure Central snubbing unit. The company returned in 2007 to drill the Ahtna 1-19A side-track well into the reservoir using a Schlumberger coiled tubing unit. And in June 2007 the company announced a gas find at a depth of 4,300 feet.





Alaska Analytical Laboratory is an environmental lab performing the following services: soil analyses for Gasoline Range Organics (GRO), BTEX (Benzene, Toluene, Ethylbenzene, and Xylene); Diesel Range Organics (DRO) and Residual Range Organics (RRO) following the SW-846 EPA/Alaska Methods.

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But the well was producing excessive amounts of water along with the gas, even though resistivity logs suggested that relatively little of this water originated in the reservoir.

And Rutter and Wilbanks Vice President Bill Rutter Jr. was convinced of a significant gas resource in the Ahтна prospect, perhaps with a gas volume in the range 50 billion to 150 billion cubic feet.

So, after a two-year hiatus while the company tried to secure the use of a suitable drilling rig, Rutter and Wilbanks returned to Glennallen in the summer of 2009 with the Schlumberger coiled tubing unit to try to plug with cement the source of water flowing into the well bore and then drill a second sidetrack well. The idea was to determine whether gas could be produced without excessive water production and to evaluate the size of the resource.

But, defeated by excessive downhole pressure and a continuing flow of water into the well, Rutter and Wilbanks finally gave up in late September, plugging and abandoning the well after something in excess of \$20 million had been sunk into the Glennallen venture over the years.

With no further Alaska exploration plans, Rutter and Wilbanks' lease position in the state has now dropped from 1,580 acres to just 320 acres.

## Nenana and Middle Tanana basins

The Nenana basin and the Middle Tanana basin underlie swampy lowland areas south and west of Fairbanks. The Tanana and Nenana rivers drain the area. The Nenana basin forms an elongated north-south trough west of the town of Nenana. The Middle Tanana basin occupies a broad area immediately south of Fairbanks.

The basins exhibit many of the characteristic features of Alaska Tertiary basins, with varying thicknesses of Tertiary non-marine fill. The early Tertiary section has been strongly deformed and eroded. The Ruby-Rampart trough to the northwest and the Cantwell trough to the south of the Nenana basin also contain significant thicknesses of early Tertiary fill.

In the Healy basin, an offshoot from the southeast corner of the Nenana basin, the mid-Tertiary Usibelli Group contains the coal seams associated with coal mining operations near Healy. The later Terti-

ary sediments in this basin consist of gravels and conglomerates that probably derived from erosion of the Alaska Range.

In 2004 Usibelli Coal Mine applied for a state exploration license, in the hopes of searching for coalbed methane in the Healy area. The proposal ran into local opposition, following concerns about the potential environmental impacts of coalbed methane development. Eventually, in June 2010, the Alaska Department of Natural Resources proposed issuing a license to allow Usibelli to explore for conventional and unconventional natural gas in 208,630 acres just east of Denali National Park and Preserve, a stretch of land that traverses the Parks Highway.

However, following further comments expressing concerns about issues such as wildlife habitat, DNR has yet to make a final decision on whether to issue the license.

People have reported oil seeps at a couple of locations in the Nenana and Middle Tanana basins but these reports have not been confirmed. Coal beds and lake-formed shales are the most likely source of hydrocarbons — coal beds in the sediments have probably created gas and could act as a source of coalbed methane.

## Close to infrastructure

The potential for finding natural gas, or perhaps even oil, in the 8,500-square-mile Nenana basin, close to the Parks Highway, the Alaska Railroad and the electrical intertie between Fairbanks and Anchorage, raises some interesting possibilities, such as the production of gas for Fairbanks utilities, or the use of Nenana gas for power generation. There's also a proposal for a spur gas line, connected to a future North Slope gas pipeline and following the Parks Highway to the Anchorage area: If viable gas is discovered in the Nenana basin, gas production might hook into that line.

But past exploration of the basin has been very limited.

Unocal drilled the Nenana No. 1 well to a depth of 3,062 feet in 1962 and ARCO drilled the Totek Hills No. 1 well to a depth of 3,590 feet in 1984. Both of these wells penetrated the shallow edges of the basin and neither found oil or gas.

According to Doyon Ltd., the Native regional corporation that owns some subsurface land in the basin, the overall basin actually consists of two subbasins separated by a saddle to the southwest of Ne-

*continued on next page*

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nana: The northern subbasin attains a maximum depth of about 20,000 feet, while the more southerly subbasin is about 14,000 feet deep.

Doyon thinks that the entire basin has the potential to hold 1 trillion to 6 trillion cubic feet of natural gas.

In 2002 the State of Alaska awarded Andex Resources, based in Denver and Houston, an exploration license with a seven-year term on 500,000 acres of state land in the basin. The company also negotiated oil and gas leases on about 41,000 acres of Doyon land and on about 9,500 acres owned by the Alaska Mental Health Trust.

Then in 2004 Andex formed a Nenana basin exploration partnership with Doyon, Arctic Slope Regional Corp. and Usibelli Energy, leading to the shooting of a 2-D seismic survey west of Nenana in the spring of 2005. Andex proceeded with the analysis of the new seismic data, to determine a site for a 10,000- to 12,000-foot wildcat well.

But in the spring of 2006, amid concerns about proposed changes to Alaska's gas production tax, Andex started to lose interest in its Nenana venture, eventually pulling out of the project in late 2007.

### Forward again

In 2008 with the Nenana exploration license set to expire in September of 2009, the State of Alaska approved an extension of the license term to 10 years, allowing the time necessary for the Doyon partnership to regroup.

In November 2008, exploration activity in the Nenana basin started to move forward again when Denver-based Babcock & Brown Energy, later to be renamed Rampart Energy, joined the exploration partnership.

On July 8 Rampart Energy spudded the Nunivak No. 1 well using the Doyon Drilling Arctic Wolf No. 2 rig from a gravel pad constructed in woodland a few miles west of Nenana. The well was targeting a 2,000-acre prospect consisting of a domelike, three-way closure on the saddle between the two Nenana subbasins, with the expectation that gas rising from a deeper part of the basin would have become trapped in the closure.

By the end of July the drill bit had reached a depth of 7,000 feet, on its way to its target at between 11,000 to 11,500 feet. However, the exploration partnership has not announced the final results of the drilling, although the rig was subsequently removed from the drilling pad.

Doyon has since expressed an intention to conduct a seismic survey in the northern part of the basin, a part of the basin where only gravity data are currently available. However, in September 2010 the Native corporation said that it had placed a hold on its plans for Nenana basin seismic data acquisition pending the resolution of some Alaska Railbelt energy supply issues that impact local gas markets in the Fairbanks region.

### Holitna, Minchumina & Innoko basins

The Holitna basin is a small Tertiary basin that straddles a major fault zone, next to the Kuskokwim River and west of the Alaska Range. The Minchumina basin is a larger basin between the central Alaska Range and the Kuskokwim Mountains.

Both basins have formed as a result of fault activity and contain coal-bearing Tertiary rocks. Although the extent of the deeper sections of the basins is fairly limited, coal in the sediments may have generated gas; sandstones within the sedimen-

tary sequence could act as reservoirs. There is also the potential for extracting coalbed methane.

In 2006, following concerns raised by local communities about potential impacts on subsistence and cultural resources, the Alaska Department of Natural Resources denied an exploration license to Holitna Energy Co. for the exploration for natural gas in part of the Holitna basin, to supply energy for the nearby Donlin Creek gold mine project, as well as for local villages. However, following an administrative appeal in Alaska Superior Court by Holitna Energy, DNR agreed to reconsider its finding and in 2009 reversed its earlier decision by issuing the license.

But the Native Village of Sleetmute has now appealed that decision in Superior Court, saying that the decision was made without adequate notice and opportunity for comment, and that there had been substantial changes to the terms of the license.

#### Paleozoic oil?

Up to 12,000 feet of older Paleozoic shales and limestones under the Holitna basin may be oil prone. Potential reservoirs exist both in this Paleozoic sequence and in the overlying Tertiary strata. The Paleozoic rocks may be overly mature for oil generation and any oil formed during the early history of the rocks may have escaped during later folding, faulting and uplift.

However, a petroliferous odor from some of the rocks and the existence of lumps of bitumen at the surface in some locations provide evidence of oil generation and migration. ARCO, Chevron, Sohio, Unocal and Alaska's Division of Geological and Geophysical Surveys all sent field parties to the area in the early 1980s, but interest waned along with the collapsing price of oil shortly afterward.

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*The Holitna basin is a small Tertiary basin that straddles a major fault zone, next to the Kuskokwim River and west of the Alaska Range. The Minchumina basin is a larger basin between the central Alaska Range and the Kuskokwim Mountains.*

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The Innoko basin is another small Tertiary basin lying in a lowland area within the Kuskokwim Mountains.

## Yukon Flats basin

The Yukon Flats consist of an approximately 15,000- square-mile lowland area around the Yukon River, between the trans-Alaska oil pipeline and the Canadian border. The flats lie over a deep sedimentary basin bounded by faults on the north and south sides. The basin is thought to contain up to about 25,000 feet of Tertiary nonmarine sediments.

The Tintina fault system that marks the southern boundary of the Yukon Flats basin extends southeast from the basin. A series of narrow, subsiding basins occurs along this fault system.

Comparisons with other Tertiary basins in Alaska suggest that the Yukon Flats basin probably contains at least some biogenic gas. However, with modern lake and river deposits obscuring the bedrock there is little means other than drilling to find evidence of an active petroleum system in the flats. A 1,281-foot core hole drilled at Fort Yukon in 1994 discovered gas bubbling from coal. A consortium of federal and state agencies and others drilled a well to a depth of 2,287 feet at the same site in 2004.

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The Texas-based independent Rutter and Wilbanks remained persistent in the face of continued challenges during its five years in Alaska, but no longer appears to have immediate exploration plans. Rutter arrived in Alaska in 2004, taking a farm-out option on leases in the Copper River basin that hadn't been explored in years, but faced obstacles each time it tried to develop gas resources in the region. In 2005, the company hit high pressure with the Ahtna 1-19 well. In the fall of 2006, the company got stuck again on its second attempt to drill. A 2007 sidetrack called Ahtna 1-19A found gas, but the gas came with excessive amounts of water that challenged the viability of the well.

In order to focus on Glennallen, Rutter pulled back from two other projects in the state, the Umiat oil prospect along the Colville River and the Northern Lights gas prospect in the waters of the upper Cook Inlet. The company hoped to drill again at Glennallen in 2008, but trouble landing a rig forced another delay. Rutter finally drilled a sidetrack in September 2009, but by the end of the month announced that it had given up on the Copper River basin after spending more than \$20 million over five years. Rutter went from

The 2004 well encountered two coal seams, both of which contained methane but exhibited rather low gas saturations.

Three wells were drilled to the east of the basin in the 1970s but failed to find any oil or gas shows.

**Oil shale**

It has long been known that loose pieces of oil shale lie in the uplands northeast of the flats. Geologists have speculated about the possibility that this shale could form an oil source under the basin but there is no direct evidence to support this possibility.

Oil companies have shot 10 seismic lines in the flats. Five of the lines dating from 1972 can be purchased through a broker. The other five lines, shot in 1988, remain confidential. In 2001 the Alaska Division of Geological and Geophysical Surveys in conjunction with the Kansas Geological Survey shot 8.5 line-miles of seismic at Fort Yukon that detected some shallow coal

NAME OF COMPANY: Rutter and Wilbanks Corp.  
 HEADQUARTERS OF PARENT COMPANY: Midland, Texas  
 CHIEF EXECUTIVE OFFICER OF COMPANY: Bill W. Rutter, Jr., vice president  
 COMPANY TELEPHONE NUMBER: 432-683-1824  
 COMPANY FAX: 432-683-1732  
 COMPANY WEBSITE: Not available currently



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leasing some 1,580 acres in Alaska in September 2009 to just 320 acres today.

**Current exploration focus:**

**Interior Alaska:** Rutter and Wilbanks spent years exploring for natural gas in the Copper River Basin near Glennallen, but does not have any current exploration plans in Alaska.

beds but did not penetrate the deeper rocks.

In a 2004 U.S. Geological Survey assessment of the basin, investigations of surface rock exposures, comparisons with similar geology elsewhere and estimates of thermal maturities at depth within the basin all pointed to a gas-prone basin with some potential for oil. USGS has suggested that gas reserves in the basin could prove comparable to the volumes of gas in Cook Inlet.

In that same year Doyon Ltd., the Native regional corporation for the Yukon Flats area, proposed the swap of some Native lands for prospective land in the Yukon Flats National Wildlife Refuge, refuge land that includes some of the deepest sections of the Yukon Flats basin. Doyon wants to see oil and gas development in the Yukon Flats to generate income for its shareholders and to create economic opportunities for local communities; the corporation saw the acquisition of the deep sections of the basin as a means of encouraging development.

**Controversy**

But the land swap proposal generated considerable controversy. Some local residents saw the potential for oil and gas development to bring economic benefit to a region hard-hit by escalating fuel costs; others viewed oil and gas development as a threat to their traditional subsistence way of life and worried

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## Exploration license holders

The State of Alaska began issuing exploration licenses in 1998 as a way to encourage drilling in prospective areas of the state not covered by lease sales. Since then, explorers have drilled in two Interior basins, but neither effort has yet led to sustained development. Still, companies continue to apply for the right to drill in frontier basins.

For years, Rutter and Wilbanks Corp. drilled natural gas wells on a 44,576-acre license, some of it eventually converted to regular leases, in the Copper River basin near Glenallen, but the drilling results ultimately proved disappointing. A joint venture lead by Rampart Energy and Doyon Ltd. drilled for natural gas in the Nenana basin in 2009, on a license area covering nearly 483,000 acres. That joint venture is considering how to proceed. A newcomer, Cook Inlet Energy, inherited a 471,474-acre license in the Susitna basin when it bought the assets of Pacific Energy Alaska, but as of yet has not announced any plans to drill in the natural gas prone area northwest of Wasilla.

The licensing process isn't quick and occasionally gets delayed by public opposition. In 2005, the state denied Holitna Energy Co. LLC's application for a license over 26,779 acres in the natural gas prone Holitna basin, but overturned the ruling in December 2009. That application is still pending, as is Usibelli Coal Mine Inc.'s 2004 application to explore for natural gas and coalbed methane on 208,630 acres in the Healy basin, near the company's long-time coal

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*The State of Alaska began issuing exploration licenses in 1998 as a way to encourage drilling in prospective areas of the state not covered by lease sales. Since then, explorers have drilled in two Interior basins, but neither effort has yet led to sustained development. Still, companies continue to apply for the right to drill in frontier basins.*

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mining operations. The State recently approved that license, but is reviewing the decision after receiving comments in opposition to the plan.

In 2008, two independent explorers proposed new exploration licenses. Berkeley GeoImaging LLC, of Oakland, Calif., requested a 72,443-acre license to explore for oil in the Crooked Creek-Circle basin in Interior Alaska east of the community of Central and south of the community of Circle. LAPP Resources Inc. requested a natural gas exploration license covering 21,080 acres in the Houston-Willow basin, an area along the southern stretch of the Parks Highway that has seen decades of interest. Both of those proposals are currently under review by the Alaska Division of Oil and Gas.

In 2010, the Alaska Mental Health Land Trust announced that it would accept exploration license application for underground coal gasification over 190,000 on three boroughs.

about the potential for environmental damage; some worried about access to surface land for subsistence hunting.

In the summer of 2005, faced with a barrage of questions about the land swap, the U.S. Fish and Wildlife Service, the agency that administers the refuge, decided to prepare an environmental impact statement for the swap. Doyon said that it supported the Fish and Wildlife decision — the EIS would provide an opportunity to address the concerns that people had raised, the Native corporation said.

But in July 2009 Fish and Wildlife announced that the result of the EIS would be a decision to take no action over the land swap proposal, thus killing any possibility of the swap taking place.

### New data

Meantime, however, new geologic data, including the results of a USGS gravity survey in the basin, pointed to some existing Doyon land as being more prospective than the Native corporation had originally thought and, in fact, threw into question the value of the original land swap plan.

In particular, the gravity survey indicated the presence of a series of subbasins within the overall Yukon Flats basin, with most of these subbasins having depths in excess of 8,000 feet. A subsequent oil and gas assessment by Petrotechnical Resources of Alaska estimated the possible existence of 300 million to 1 billion barrels of oil in the basin, and perhaps 1 trillion cubic feet of natural gas, an assessment that opened the possibility of an oil field equivalent in size to the North Slope Alpine field under the forests and marshes of the Yukon Flats.

And with some of the prospective subbasins not too distant from the trans-Alaska oil pipeline, Doyon says that it will now focus

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*In 2010 Doyon acquired 96 miles of 2-D seismic, and some soil samples and gravity data, over one of the Yukon Flats subbasins near Stevens Village. The corporation is analyzing the new data and merging it with some older data before deciding whether to do further appraisal work or to seek a Yukon Flats exploration partner.*

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on oil and gas exploration opportunities in its existing Yukon Flats lands, working with the communities that support development.

In 2010 Doyon acquired 96 miles of 2-D seismic, and some soil samples and gravity data, over one of the Yukon Flats subbasins near Stevens Village. The corporation is analyzing the new data and merging it with some older data before deciding whether to do further appraisal work or to seek a Yukon Flats exploration partner.

### Exploration license

In December 2007, BGI North America LLC applied for a state oil and gas exploration license covering around 72,443 acres of state land in the Crooked Creek-Circle basin, located east of the community of Central and south of the community of Circle, and forming one of the small basins along the Tintina fault system to the southeast of the main Yukon Flats basin. Alaska's Division of Oil and Gas is in the process of developing a best interest finding for this exploration license.

In its 2004 assessment of the Yukon Flats, USGS estimated that the Crooked Creek area could contain 160 billion cubic feet of technically recoverable natural gas and 6.47 million barrels of technically recoverable oil.

## Northern Alaska & Arctic offshore

By Alan Bailey

Petroleum News Senior Staff Writer

**I**n 1968 the discovery of the giant Prudhoe Bay oil field, the first field to be discovered on Alaska's North Slope and among the 20 largest oil fields ever discovered worldwide, triggered a northern Alaska oil industry that now includes 19 producing oil fields, all feeding oil into the trans-Alaska oil pipeline for transportation to the Valdez Marine Terminal 800 miles to the south.

In fact, the totality of northern Alaska consists of five distinct geologic regions: the Brooks Range, the Brooks Range foothills (also known as the Arctic foothills), the North Slope (also known as the Arctic coastal plain), the Beaufort Sea and the Chukchi Sea. The central North Slope and the nearshore area of the Beaufort Sea contain all of the current operational oil fields in northern Alaska. The western North Slope includes part of the National Petroleum Reserve-Alaska, or NPR-A.

NPR-A extends from the shoreline south across the western coastal plain and Brooks Range foothills, into the north side of the Brooks Range. The eastern North Slope includes the 1002 area of the Arctic National Wildlife Refuge, the area that has long been the subject of controversy regarding whether it should be opened for oil and gas exploration. ANWR extends south into the Brooks Range, but only the 1002 area is considered prospective for oil and gas.

The Brooks Range consists of east-west-trending mountain groups that reach heights in excess of 6,000 feet. There is little to no oil or gas potential in much of the Brooks Range proper, although rocks exposed at the surface provide valuable insights into many of the petroleum source rocks and reservoir units that occur in the subsurface to the north.

The folded and thrust faulted zone that marks the northern front of the Brooks Range runs generally eastward from the

shores of the Chukchi Sea north of Cape Lisburne to a point near the trans-Alaska oil pipeline south of Prudhoe Bay, before turning northeast through the northern part of ANWR.

The Brooks Range foothills between the Brooks Range front and the North Slope consists of a series of rolling hills, mesas and east-west trending ridges with elevations from 900 to 1,500 feet. The rocks exposed in the foothills are younger and less deformed than those in the Brooks Range to the south.

### Continental shelf

The continental shelf of northern Alaska extends north beneath the shallow Beaufort Sea for about 50 miles to a series of geologic faults that mark the edge of the Arctic Ocean continental slope. The geology of the continental shelf forms an extension of the onshore geology of the region — there are two operational oil fields in the Beaufort Sea, Northstar and Endicott, both geologically related to the onshore fields and both connected into the North Slope oil infrastructure.

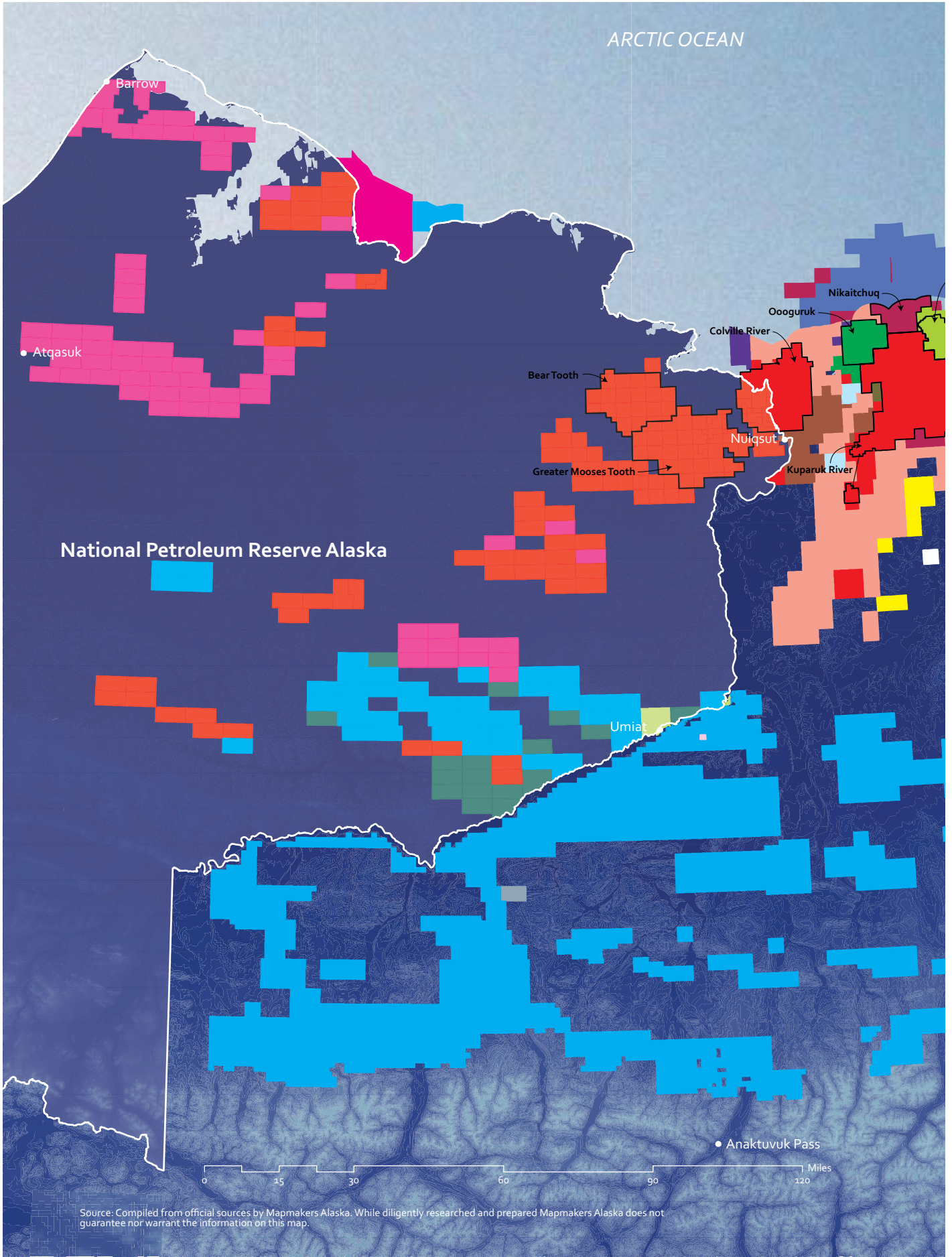
The Chukchi Sea extends over a vast offshore region, west of the North Slope and Brooks Range foothills. With huge geologic structures that correlate with the hydrocarbon-rich geology on the mainland of northern Alaska, the rocks under the Chukchi Sea contain all of the necessary ingredients for a world-class oil and gas province. Limited exploration in the 1990s yielded a major gas discovery that still awaits development. It's even possible that there's a Prudhoe Bay-scale oil field in the area.

And across this whole vast region of northern Alaska, the petroleum system consists essentially of three major rock sequences: The oldest and generally deepest of the sequences, the

*continued on page 64*



ARCTIC OCEAN

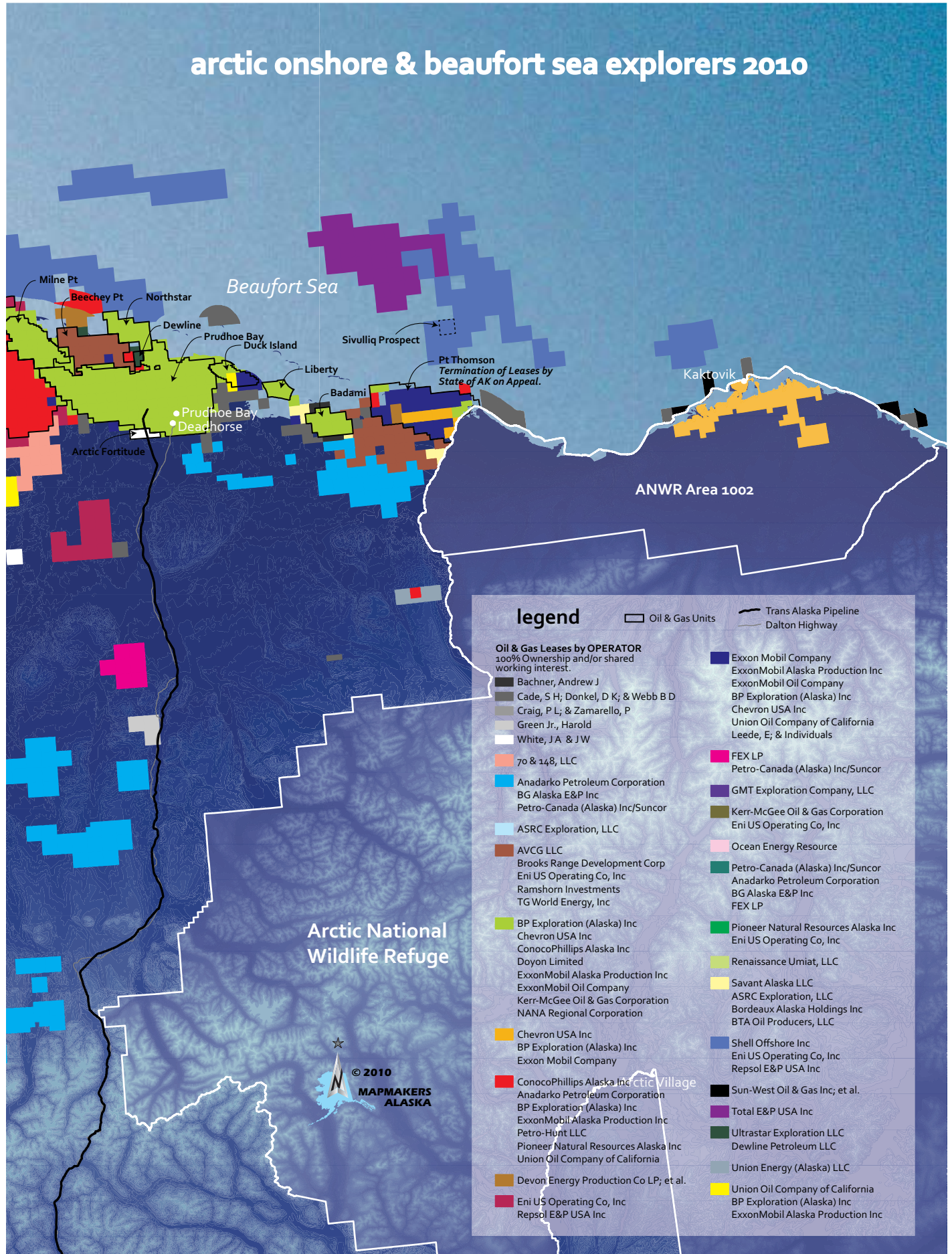


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# arctic onshore & beaufort sea explorers 2010





BP Exploration opened its first office in Alaska in 1959, and drilled a confirmation well for the Prudhoe Bay discovery a decade later. Today it operates the unit and its satellites and participating areas, as well as other North Slope units like Duck Island, Milne Point, Northstar and Badami. BP owns a share in two other major North Slope units, Kuparuk River and Point Thomson, as well as the largest share of the trans-Alaska oil pipeline.



JOHN MINGÉ

BP dropped its exploration acreage in 2003, but is still trying to bring additional resources online. In the short term, BP is aiming to slow production declines through additional drilling (62 wells in 2009 and roughly the same planned for 2010), reservoir modeling and pressure management, and recovery techniques like miscible injection and water flooding. Longer term, BP hopes bring new production online through three large projects. BP recently completed a \$100 million facility for testing heavy oil production methods west of Prudhoe Bay. In a joint venture with ConocoPhillips, BP held an open season this year for a multibillion-dollar natural gas pipeline from the North Slope to southern markets. Finally, BP planned to use one of the most powerful rigs in the world to drill the offshore Liberty prospect from existing

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onshore facilities, but delayed the plan at least a year while the federal government reviews offshore drilling programs in the wake of BP's oil spill in the Gulf of Mexico. Since the spill, rumors have been spreading that BP plans to sell some of its Alaska assets to raise capital, but as of yet

those rumors have failed to materialize. BP produced 181,000 per day of liquids in Alaska in 2009 and leases nearly 310,000 state acres.

**Current exploration focus:**

**Northern Alaska:** BP withdrew from conventional Alaska oil and gas exploration in the early 2000s to focus on developing new oil resources from existing fields, especially Prudhoe Bay. The company is testing heavy oil production methods on the North Slope, and is involved in a joint government-industry-university project to investigate the possibility of producing natural gas from North Slope methane hydrate deposits.

**Northern Alaska:** BP is developing the Beaufort Sea Liberty field using ultra extended-reach drilling from the Endicott satellite island, but federal reviews could delay drilling.

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Ellesmerian, hosts fields such as Prudhoe Bay, Endicott and Lisburne. The Beaufortian sequence hosts the Kuparuk and Alpine fields. The Brookian, the youngest and generally shallowest sequence, hosts fields such as Badami and Tarn. All of the operational fields are aligned along a major geologic structure called the Barrow arch.

**Current exploration and development trends**

It is perhaps helpful to consider oil exploration and development in Arctic Alaska in the context of five distinct but interrelated trends:

- Oil exploration in and around the existing central North Slope oil infrastructure;
- Exploration west from existing infrastructure into the National Petroleum Reserve-Alaska;
- Exploration east from the central North Slope oil infrastructure towards the Arctic National Wildlife Refuge;
- Exploration on the outer continental shelf of the Beaufort and Chukchi seas; and
- Exploration, primarily for natural gas, in the Brooks Range foothills.

**Central North Slope**

In the central North Slope operators BP and ConocoPhillips have been using high-tech drilling techniques and various meth-

*continued on page 66*

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ods of teasing as much oil as possible from field reservoirs to extend the life of legacy fields such as Prudhoe Bay and Kuparuk River, and to maximize the ultimate recoverable reserves from these fields.

Around the established central North Slope fields, small independent companies such as Brooks Range Petroleum are seeking modest-sized oil accumulations that may prove viable for development because of the proximity of the established infrastructure. In the nearshore waters of the Beaufort Sea, offshore the central North Slope, Pioneer Natural Resources has demonstrated with its highly successful Ooguruk field that an independent oil company can bring a new oil field into production in the challenging Arctic environment. And Eni Petroleum is about to bring its nearshore Beaufort Sea Nikaitchuq field online.

### The National Petroleum Reserve-Alaska

ConocoPhillips with its partner Anadarko Petroleum has been spearheading exploration and development west from the Colville River Delta, at the western extremity of the existing oil infrastructure, into the northeastern part of NPR-A. The partnership has found some modest sized oil accumulations that might be viably developed by extending the oil pipeline infrastructure west from the central North Slope.

The concept is to progressively move farther and farther west into NPR-A, opening up new oil pools as access to the pipeline infrastructure becomes available.

But progress has currently come to a halt because the U.S. Army Corps of Engineers has refused to permit the construction of an access bridge across the Nigliq Channel of the Colville River. ConocoPhillips says that it needs this bridge to develop

the first of the NPR-A fields, Alpine West, from the CD-5 drilling pad.

ConocoPhillips, Anadarko and Talisman subsidiary FEX have all also explored much farther west in NPR-A, but viable oil and gas development in this remote country at such large distances from the existing oil infrastructure would require a major oil find.

### East toward ANWR

ExxonMobil's work to bring the huge Point Thomson gas condensate field into production, coupled with Savant Alaska and BP's efforts to bring the Badami oil field back online, have thrown new attention on exploration and development possibilities onshore, east of the Prudhoe Bay oil infrastructure. Although the coastal plain of the Arctic National Wildlife Refuge remains off limits to the oil and gas industry, and seems set to remain off limits for the foreseeable future, previous exploration has discovered new oil in the Point Thomson-Badami area.


Perhaps the presence of an active oil pipeline system extending to Point Thomson, close to the western border of ANWR, might encourage the opening up of this area of the North Slope to further developments.

### The Beaufort and Chukchi seas


Many people see the outer continental shelf of the Beaufort and Chukchi seas as the best bet for finding major new oil and gas fields that could maintain the flow of oil through the trans-Alaska oil pipeline and perhaps support the economics of a North Slope gas line. However, a very large find would presumably be needed to justify the extreme cost of developing the necessary infrastructure to bring oil or gas to market from these remote regions, especially from the Chukchi Sea.

Shell has led the charge in opening up these remote offshore regions by leasing large numbers of OCS tracts, shooting offshore seismic and establishing plans for drilling in OCS prospects, some of which are known to contain oil or gas. And ConocoPhillips has stated its strategic intent to focus its future northern Alaska exploration efforts on the Chukchi Sea, rather than pursuing onshore possibilities in remote locations.

*continued on page 69*




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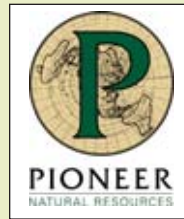
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Pioneer Natural Resources earned its name in 2008 by bringing the Oooguruk unit into production and becoming the first independent producer on the North Slope. The Texas-based company arrived in Alaska in 2000, promising a quicker schedule for bringing oil exploration prospects into sustained production. Pioneer bought a majority stake in the Northwest Kuparuk prospect — the offshore leases that eventually became Oooguruk — and quickly racked up other leases across the state, but after unpromising drilling efforts, the company decided to shift its focus away from exploration in favor of production.

After dropping significant acreage over the years, Pioneer currently leases some 66,000 net acres divided between the North Slope and Cook Inlet. The company continues to increase production rates at Oooguruk and in 2011 plans to continue development drilling into three

**NAME OF COMPANY:**  
Pioneer Natural Resources  
**HEADQUARTERS OF PARENT COMPANY:**  
Dallas, Texas  
**CHIEF EXECUTIVE OF PARENT COMPANY:**  
Scott D. Sheffield Chairman and CEO  
**HEADQUARTERS IN ALASKA:**  
**TOP EXECUTIVE IN ALASKA:** Ken Sheffield,  
Vice President – Alaska, Pioneer Natural Resources  
**MAIN ALASKA TELEPHONE NUMBER:** 907-277-2700  
**ALASKA FAX:** 907-343-2190  
**COMPANY WEBSITE:** www.pxd.com



reservoirs at the unit, the Nuiqsut, Kuparuk and the new Moraine horizons. Pioneer is also looking at Cosmopolitan, a Cook Inlet oil prospect that the state describes as having “substantial” gas potential. A sidetrack in late 2007 tested at 400 to 500 barrels per day of oil, but the company postponed further drilling plans when commodity prices dropped at the end of 2008. The company is now deciding whether to sanction development of the prospect.

Pioneer produced some 6,750 barrels of oil per day in 2010.

**Current exploration focus:**

**Northern Alaska:** Currently, Pioneer Natural Resources is not exploring on the North Slope, but continues to expand development drilling at the offshore Oooguruk field.

**Cook Inlet:** Pioneer is evaluating the Cosmopolitan oil and natural gas prospect.



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But concerns about the potential environmental impacts of offshore development and about the possible impacts of offshore industrial activities on Native subsistence hunting have resulted in a succession of court cases, challenging government approvals of offshore oil leasing and drilling. And concerns about offshore drilling safety following the Deepwater Horizon disaster in the Gulf of Mexico have exacerbated the situation, with the U.S. Department of the Interior prohibiting Shell from drilling in the Beaufort and Chukchi seas in 2010.

BP is taking a different approach to OCS oil development by using ultra-extended-reach drilling to develop its Beaufort Sea OCS Liberty field from an extended manmade gravel island at the nearshore Endicott field. But Liberty has also come under a cloud of fallout from the Deepwater Horizon disaster, with BP delaying development into 2011 pending a Department of the Interior review of the environmental assessment for the field.

### Brooks Range foothills

Although there is a known oil field being evaluated by Renaissance Alaska at Umiat, about halfway down the eastern side of NPR-A on the northern side of the Brooks Range foothills, most geologists view the foothills region as more prospective for natural gas than for oil. Anadarko, along with various partners, has been leading the way in seeking gas opportunities in this region, and has been drilling in some known gas accumulations, motivated by the possibility of a future North Slope gas line or the possibility of a pipeline feeding gas into Southcentral Alaska.

The State of Alaska has been moving ahead with the permitting of a road west from the Dalton Highway (known locally as the haul road) to Umiat, to encourage oil and gas development in the Umiat area.

## Central North Slope and nearshore Beaufort Sea

With more than 15 billion barrels of crude oil having flowed down the trans-Alaska pipeline since the startup of the giant Prudhoe Bay field in 1977, and with vast quantities of natural gas recycled into oilfield reservoirs for reservoir pressure maintenance and for possible future export, the central North Slope remains at the fulcrum of the Alaska oil industry. And a cluster of fields, including the Kuparuk River field, one of the largest producing oil fields in North America, has supported an oil infrastructure that spreads out from the original Prudhoe Bay field, an infrastructure that offers the possibility of hooking up modest-sized new discoveries for commercial operation.

Over the last two decades exploration on the North Slope has shifted away from prospecting for fields akin to Prudhoe Bay in size and configuration. This change has resulted not only from the fact that very large oil traps of that type have been virtually exhausted in the onshore and nearshore areas, but also because better seismic data are available now for defining a large number of smaller, subtler traps.

In general terms, people widely recognize the petroleum systems of northern Alaska as hydrocarbon-rich but reservoir-poor. So, with an abundance of excellent source rocks and a relative shortage of reservoir-quality rock formations, any isolated stratigraphic trap, a hydrocarbon trap formed by the juxtaposition of reservoir and seal rocks in the rock strata, stands

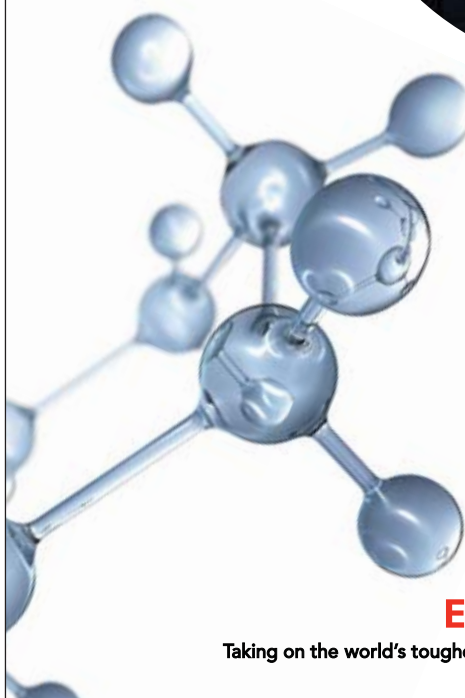
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a good chance of containing oil or gas. Recent exploration has exploited the new found capabilities of high-end 3-D seismic techniques to find these stratigraphic traps.

### Moving west

To the west of Prudhoe Bay the 1994 discovery by ConocoPhillips' predecessor, ARCO, and Anadarko Petroleum of unexpectedly prolific sands at Alpine opened the door to extending a new Beaufortian play beyond the Prudhoe-Kuparuk infrastructure. Perched on the border between state lands and NPR-A, Alpine drove the decision to reopen federal acreage on the western North Slope to exploration.

A series of wells drilled by ConocoPhillips and Anadarko in the northeastern corner of NPR-A since the renewal of leasing there in 1999 have tested Alpine-equivalent prospects and have yielded discoveries of light oil, condensate and gas in stratigraphic traps overlooked before the advent of 3-D seismic imaging.

### Profitable near infrastructure

Back near the core area of the central North Slope, the high-performance Beaufortian reservoir of the ConocoPhillips Palm discovery on the western edge of the Kuparuk field led to the construction of a new drill site and expansion of the Kuparuk River unit. This development serves as a reminder of how profitable exploration success close to the existing infrastructure can become, with a cluster of small satellite fields now operated by BP and ConocoPhillips around the major fields of Prudhoe Bay, Kuparuk River and Alpine.

And small independents Brooks Range Petroleum Corp. and

UltraStar Exploration LLC have been pursuing this type of exploration concept in recent years.

BRPC, the operating company for Alaska Venture Capital Group, a private investment group headed by Managing Director Ken Thompson, is leading a joint venture with three other private companies in a multiyear program to explore for light oil close to North Slope infrastructure. BRPC exploration is progressing in the area of Gwydyr Bay, on the Beaufort Sea coast north of the Prudhoe Bay unit.

BRPC drilled the North Shore No. 1 and the Sak River No. 1 wells in that area during the winter of 2006-07. In the following year the company sidetracked and tested North Shore No. 1 at more than 2,000 barrels of oil per day of high quality crude oil from the Ivishak formation. And in August 2009 Alaska's Division of Oil and Gas approved the formation of the Beechey Point unit at North Shore — BRPC wants to fast track development of the find, perhaps using trucks to transfer the North Shore oil to a tie-in with the Kuparuk pipeline, with the development of several small oil accumulations in the area as a future possibility.

In early 2010 BRPC sidetracked the Sak River No. 1 well, finding porous sandstones with oil shows, but also with a substantial amount of water, in the Kuparuk formation.

In the winter of 2007-08 the BRPC joint venture drilled the Tofkat No. 1 well east of the village of Nuiqsut, taking 10 oil samples from four different sandstone reservoirs and finding six feet of net pay in the Kuparuk formation, the deepest zone tested.

The joint venture also drilled two sidetracks to find the edge of the Tofkat reservoir, and acquired 210 square miles of 3-D seismic over the prospect, previously called Titania.

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Most independents come to Alaska looking for smaller fields passed over by the majors, but Anadarko Petroleum arrived in the early 1990s looking for big “anchors.” The large Texas independent formed partnerships with much bigger players, offering fresh ideas in return for first-hand Arctic experience. The most successful of those partnerships has been with ConocoPhillips and its predecessor companies. Anadarko and Phillips Alaska brought the Alpine oil field online in 2000 and have since developed several satellites of the field just west of the Kuparuk River unit. Anadarko and ConocoPhillips are now partnering to develop Greater Mooses Tooth, the first unit in the National Petroleum Reserve-Alaska, but federal permitting problems this year stalled that effort. Anadarko leases some 4 million acres in Alaska and had net production of some 17,000 net barrels of oil per day this year. Over two decades, Anadarko has pursued other targets in Alaska with other partners, to varying degrees of success. Anadarko found gas in Cook Inlet, but sold the acreage, and hit pay with the Altamura No. 1 wildcat, but abandoned the well after encountering low permeability. More recently, Anadarko drilled, but then relinquished, the Jacob’s Ladder unit, a geologically unique prospect southeast of Prudhoe Bay.

Anadarko is now focused on exploring for natural gas in the Gubik Complex, in the western foothills of the Brooks Range. In 2008 and 2009, Anadarko and partners BG and Petro-Canada

**NAME OF COMPANY:** Anadarko Petroleum Corp.  
**HEADQUARTERS OF PARENT COMPANY:** The Woodlands, Texas  
**HEADQUARTERS IN ALASKA:** Anchorage  
**TOP EXECUTIVE IN ALASKA:** Mark Hanley  
**MAIN ALASKA TELEPHONE:** 907-273-6300  
**ALASKA FAX:** 907-563-9479  
**COMPANY WEBSITE:** www.anadarko.com



MARK HANLEY

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drilled four wells, all encountering natural gas. Anadarko did not drill in 2010, though, and said it likely wouldn’t drill in 2011 either. The company still hopes to put together another multiyear program, but relinquished some 300,000 acres this summer, saying it couldn’t arrange a drilling program in remote corners of the prospect before those leases expired. Success at Gubik now depends on several factors outside Anadarko’s control, including the fate of several out-of-state and in-

state natural gas pipeline proposals, and whether partner Suncor, which inherited a stake in Gubik by acquiring Petro-Canada, stays in Alaska. However, Anadarko stands to gain from renewed state efforts to build roads to Umiat and Nome. As BP’s partner in the Gulf of Mexico, Anadarko could be on the hook for some of the multibillion dollar clean-up costs after a major summer oil spill, a liability the company is strongly contesting.

**Current exploration focus:**

**Northern Alaska:** Along with operator ConocoPhillips, Anadarko continues to explore in the northeast National Petroleum Reserve-Alaska, seeking more satellite fields to connect to the Alpine field infrastructure, but plans for the first NPR-A oil production have been delayed since the federal government denied the companies a key permit in February.

**Northern Alaska:** In 2008 and 2009, Anadarko drilled exploration and delineation wells around known natural gas fields in Gubik Complex in the foothills of the Brooks Range mountains, but did not drill in 2010 and has not announced future drilling plans.

**More BRPC exploration**

And in 2011 the joint venture plans to drill in its North Tarn prospect, in leases farmed in from Eni Petroleum near the Colville River on the west side of the Colville River unit. TG

World, one of the joint venture partners has said that North Tarn may hold 21 million to 72 million barrels of recoverable oil in Brookian sands, with the possibility of another 6 million barrels in deeper Kuparuk C sands.

To the east of the central North Slope oil infrastructure, BRPC wants to shoot 130 square miles of 3-D seismic over the western half of the Brookian Slugger prospect, south of Point Thomson and not too distant from the Badami field.

UltraStar consists of another group of private investors, this

*continued on page 74*

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time under the leadership of Managing Member Jim Weeks. For a number of years UltraStar and its sister company Winstar have been doggedly trying to drill for small oil accumulations close to infrastructure, with the intent of hooking any viable discovery into existing North Slope production facilities and oil export arrangements.

In 2003 Winstar drilled the Oliktok Point State No. 1 well, which turned out to be a dry hole.

Undeterred, UltraStar moved ahead with a plan to drill its Dewline Deep prospect north of Prudhoe Bay, testing rocks equivalent to the Prudhoe Bay field reservoir, as well as some secondary targets. Eventually, after a multiyear effort to find a workable combination of drill site and drilling rig, in early 2009 the company drilled the Dewline No. 1 well vertically from an ice pad using the Doyon Arctic Wolf rig, under an arrangement with Rampart Energy, the company which had subcontracted the use of this rig from FEX to drill for gas in the Nenana basin in the summer of 2009.

UltraStar has remained tight lipped about the Dewline drilling results but appears to be sufficiently encouraged to want to drill a second Dewline well in 2012.

On the southeast side of the Kuparuk River unit, Italian oil major Eni Petroleum drilled two wells in its Rock Flour unit in the winter of 2006-07, and one well at its Maggiore unit to the south of Rock Flour in that same year. Eni had entered Alaska in 2005 with its purchase of Armstrong Oil and Gas's Alaska interests, following that deal with the 2006 purchase of the state leases that included Rock Flour and Maggiore.

#### Eni relinquishes leases

Eni has not announced the results of its North Slope explo-

ration drilling but its relinquishment of all of its Rock Flour and Maggiore leases in the summer of 2010 would appear to indicate a lack of commercial oil and gas finds.

On the southwest side of Kuparuk, Pioneer Natural Resources announced in May 2006 that it had found oil in Beaufortian and Brookian horizons in its Cronus No. 1 well, but that the reservoir formations were too tight for viable production. Pioneer's Hailstorm No. 1 well, south of Prudhoe Bay, drilled shortly before the Cronus well had proved to be a dry hole.

ConocoPhillips and Pioneer drilled the Antigua No. 1 well south of Prudhoe Bay in that same 2005-06 drilling season, but Pioneer later announced that well to be "unsuccessful."

Immediately south of Prudhoe Bay, the Alaska Department of Natural Resource has placed the Arctic Fortitude unit in default because, the department said, operator Alaskan Crude Corp. has failed to meet an obligation to move a drilling rig on site to reenter the Burglin 33-1 well. The status of the unit is currently the subject of litigation between Alaskan Crude and the state in state Superior Court.

#### Nearshore Beaufort Sea

Another possibility for explorers seeking opportunities near the existing infrastructure is to look north, under the nearshore waters of the Beaufort Sea. In fact, the BP-operated Endicott field, discovered in 1978 and involving a Barrow Arch Ellesmerian play, has demonstrated for a couple of decades that production from a nearshore oil field can prove profitable. Endicott operates from an artificial island connected by causeway to the mainland.

And although BP's 1983 Mukluk well in Harrison Bay, the most expensive dry hole in oil industry history, perhaps didn't set a good precedent for nearshore Beaufort Sea exploration, other projects have demonstrated that success is possible, despite the high economic barriers to offshore development.

BP, apparently undeterred by Mukluk, successfully brought the 202 million-barrel Northstar oil field (formerly known as Seal Island), just north of Prudhoe Bay, into production in 2001 from an artificial island. Northstar produces oil from the Ellesmerian Ivishak formation that forms the main reservoir at Prudhoe Bay. Fault blocks on the northern flank of the Barrow Arch trap the reservoir sand.

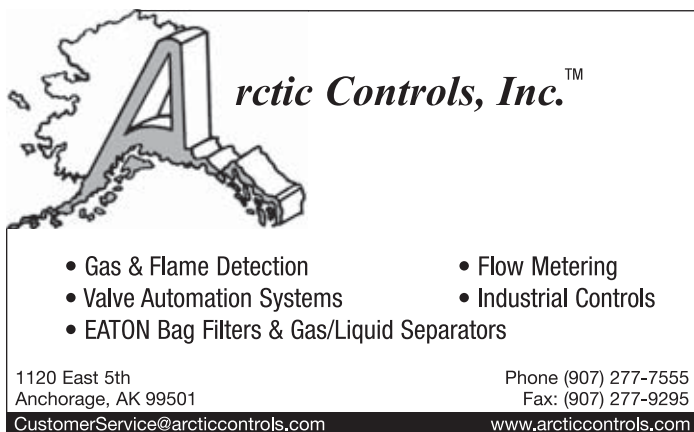
In 2002 Armstrong Oil and Gas, a small but feisty oil independent, permitted three Beaufort Sea wells in the shallow waters of Harrison Bay, northwest of the Kuparuk River unit. And, following the closure of a deal in which Pioneer Natural Resources took a 70 percent interest in the Armstrong leases, Pio-



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neer drilled the wells, thus discovering the 120 million- to 150 million-barrel Oooguruk field in March 2003.

When Eni Petroleum purchased Armstrong's Alaska assets in 2005, those assets included Armstrong's remaining interest in Oooguruk.

In June 2008 the start of production from Oooguruk, operated by Pioneer from an artificial island, brought the first northern Alaska oil from an independent producer online. The bulk of Oooguruk production, which has been exceeding expectations, comes from two distinct Beaufortian sand reservoirs, the Kubaruk and the Nuiqsut, although in May 2010 Pioneer announced that it is also developing a third, shallower reservoir. Pioneer is in the process of working through its development drilling program at Oooguruk to maximize field production, but has stated that it expects to use knowledge gained at Oooguruk to seek new development opportunities in the area around the existing field.

### Nikaitchuq

In January 2004 Armstrong pulled off a deal similar Oooguruk by persuading Kerr-McGee to acquire 70 percent of Armstrong's Nikaitchuq unit, near Oliktok Point on the east side of Harrison Bay, and then experiencing the satisfaction of Kerr-McGee's discovery of the 180 million-barrel Nikaitchuq field shortly afterward. The Nikaitchuq oil occurs in two distinct reservoirs: light oil in the Ellesmerian Sag River sandstone and more viscous oil in the Brookian Schrader Bluff formation.

Eni started buying into the Nikaitchuq field in 2005, as part of its purchase of Armstrong's assets, and since 2007 has had 100 percent ownership of the field. The company is progressing

development at Nikaitchuq and anticipates the start of production from the Schrader Bluff formation in early 2011.

Savant Alaska LLC was less fortunate in 2008 when testing its Kupcake prospect in the Beaufortian Kemik sands, in state Beaufort Sea acreage not far from BP's outer continental shelf Liberty field. The company plugged and abandoned its Kupcake No. 1 well after finding "water-wet" Kemik sands at a depth in excess of 10,000 feet.

In a state lease sale held in October 2008, Armstrong, under the name 70 & 148 LLC, re-entered the northern Alaska oil industry by purchasing acreage south of the Kubaruk River, in the White Hills area south of the Prudhoe Bay unit and near the Oooguruk unit in the Beaufort Sea, but there's no word yet of the company initiating any exploration activity in any of this acreage. In 2007 the company had purchased acreage in the southern Kenai Peninsula, in Southcentral Alaska, and has since drilled a gas well there.

In the February 2010 state Beaufort Sea lease sale GMT Exploration, a subsidiary of GMT Capital Corp., picked up some leases near the Oooguruk field and north of the onshore Colville River unit.

### Brookian plays

Exploration interest in the Brookian, the youngest and shallowest of the petroleum-bearing rock sequences of northern Alaska, mushroomed in the mid-1990s with successful tests of the mid-Cretaceous Tarn sands adjacent to the Kubaruk River field, the subsequent development of several Brookian Kubaruk satellite fields by ConocoPhillips and a move by BP to commer-

*continued on next page*

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Italian major Eni Petroleum took its first stab at Alaska in the late 1960s as Agip Petroleum, but didn't begin exploring in earnest until it bought a portfolio of North Slope leases from Armstrong Alaska in the summer of 2005. Eni brought the weight and pockets of a major to prospects being explored mostly by independents. Within a few years, the company drilled several exploration wells in the central North Slope south of Prudhoe Bay, but in recent winters shifted its focus from exploration to development.

In June 2008, Eni Petroleum became a producer in Alaska through its minority stake in the offshore Oooguruk unit, located in the state waters of the Beaufort Sea. Now, after delays caused by economics and hurricanes, Eni plans to bring the neighboring offshore Nikaitchuq unit online by early 2011. Those near-shore prospects are Eni's focus in Alaska for the foreseeable future. The company farmed out one central North Slope prospect, North

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**HEADQUARTERS OF PARENT COMPANY:**  
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Tarn, to a group of independents in January, and rather than fulfill drilling commitments at two other central North Slope prospects, Rock Flour and Maggiore, Eni relinquished the acreage this summer, comprising almost 40 percent of its Alaska landholdings. Eni currently holds nearly 143,500 acres of state onshore and offshore leases.

**Current exploration focus:**

**Northern Alaska:** Eni plans to bring the Beaufort Sea Nikaitchuq unit online in 2011 by developing the Schrader Bluff OA sand, and might someday develop other sands in the unit.

**Northern Alaska:** Eni conducted some 3-D seismic surveying on leases own jointly with Shell in the Beaufort Sea in Harrison Bay. Eni could benefit from Statoil's plans to conduct a 3-D seismic survey on Chukchi Sea leases owned jointly by the companies.

cialize an earlier discovery of oil at Badami, the most easterly of the North Slope oil fields.

Exploration 3-D surveys began to carpet not only the areas flanking known production, but increasingly areas where potentially productive trends could be extrapolated using 2-D data. In the eastern North Slope, BP and partners added oil finds at Sourdough and Yukon Gold to a previous find at Flaxman Island, as potential satellites to the Point Thomson field, the huge gas condensate field near the western border of the Arctic National Wildlife Refuge.

Unfortunately, development drilling at Badami confirmed earlier hints from both seismic and well data that its sand reservoir was less continuous and more highly compartmentalized than hoped. Production there fell far short of expectations and the history of the field has been one of periodic shutdowns and

startups.

The field has been in warm shutdown since 2007 but, in early 2010, under a 2008 farm-in agreement with Savant Alaska, Savant drilled a sidetrack from one of the existing Badami wells, hoping to improve production rates by threading a horizontal well through the complex Badami reservoir.

Savant has also been conducting some exploration drilling in the Badami unit. In early 2010 the company completed its Red Wolf well to test a prospect in the Ellesmerian Kekiktuk formation, below and southwest of the Brookian Badami reservoir — the Kekiktuk is the reservoir formation for the Endicott field. The company is rumored to have found oil in the Kekiktuk but has not yet made any statement about this.

*continued on page 78*

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ConocoPhillips can trace its roots to the start of the modern Alaska oil industry in the 1950s and has played some role in almost every major trend in the Alaska oil industry over the five decades since. In the 1960s its predecessor company ARCO joined with Humble Oil to drill the Prudhoe Bay State No. 1, the Prudhoe Bay discovery well.

Over the past 30 years, ConocoPhillips and its predecessors drove westward expansion on the North Slope: the Kuparuk River unit in 1981, the Alpine field in the Colville River unit in 2000 and Alpine satellites in 2006. ConocoPhillips was the most active explorer in the National Petroleum Reserve-Alaska over the 2000s, and is now looking at an exploration program focused on offshore prospects in the Chukchi Sea. All the while, the company also became the largest natural gas producer in the Cook Inlet.

After reportedly running out of drilling prospects that had largely been identified by predecessor ARCO Alaska, ConocoPhillips did not drill exploration wells on state acreage in Alaska last winter, but the company has continued development work in state producing units and some exploration-related activities in NPR-A, it has formed two units, Greater Mooses Tooth and Bear Tooth. But NPR-A development and production continues to be delayed. The U.S. Army Corps of Engineers denied ConocoPhillips a key development permit in February 2010, a decision ConocoPhillips appealed.

After dropping its Beaufort Sea leases, ConocoPhillips' major exploration focus became a lease package in the Chukchi Sea. The

NAME OF COMPANY:  
ConocoPhillips Alaska  
HEADQUARTERS OF PARENT COMPANY: Houston, Texas  
CHIEF EXECUTIVE OFFICER OF PARENT COMPANY: Jim Mulva  
HEADQUARTERS IN ALASKA: Anchorage  
TOP EXECUTIVE IN ALASKA: Trond-Erik Johansen  
MAIN ALASKA TELEPHONE: 907-276-1215  
ALASKA FAX: 907-265-1410  
COMPANY WEBSITE: www.conocophillipsalaska.com



TROND-ERIK JOHANSEN

company plans to drill an exploration well by as soon as 2013, but ongoing litigation, federal regulatory reorganization and increased scrutiny of offshore drilling in the wake of the Deepwater Horizon oil spill could delay that program. In a joint venture with BP, ConocoPhillips held an open season this year for a multibillion-dollar natural gas pipeline from the North Slope to southern markets. In 2010, the company also presented

plans to increase deliverability and recovery at the Beluga River unit, one of the most productive natural gas fields in the Cook Inlet basin.

ConocoPhillips is the largest oil and gas producer in the state, booking 252,000 barrels of oil per day and 94 million cubic feet of gas per day in Alaska in 2009. The company leases 1,854,295 net acres onshore and offshore of state, federal and Native land in Alaska.

**Current exploration focus:**

ConocoPhillips is focused on western expansion into NPR-A and Arctic OCS exploration in the Chukchi Sea. The company hopes to develop prospects in NPR-A, seeking more satellite fields to hook into existing Alpine field (Colville unit) infrastructure. Those plans, however, depend on resolving permitting disputes with federal agencies. ConocoPhillips is gathering 3-D seismic data and doing well-site preparation work in the Chukchi Sea in preparation for drilling an exploration well at the Devil's Paw prospect, formerly known as Klondike. Working with the U.S. Department of Energy, ConocoPhillips is also investigating the possibility of producing natural gas from North Slope methane hydrate deposits.

In the Cook Inlet basin, ConocoPhillips is continuing development drilling in existing gas fields.

With Savant having completed the Badami horizontal side-track and Red Wolf wells, BP has been readying the Badami pipeline and production facilities for a field restart, with Savant saying that it expects an initial production rate of about 4,000 barrels per day. Some of that production will come from the Red Wolf well, from a secondary target in the late Cretaceous Killian sands that occur above the Kekiktuk.

Other exploration of the Brookian sand play continued over the years, apparently without much success, with drilling at the McCovey prospect offshore near Reindeer Island; the Heavenly and Grizzly wells south of Kuparuk; and the Hunter well in NPR-A. And companies continue to evaluate the play in NPR-A and elsewhere on the North Slope, sometimes as a secondary target.

Perhaps success at Badami with horizontal drilling techniques will open the door to development of similar eastern North Slope stratigraphic traps, known to exist but not evaluated in detail.

And in the central North Slope ConocoPhillips and BP have enjoyed considerable success in using horizontal drilling to develop viscous oil in Brookian sands above the Prudhoe Bay and Kuparuk River fields. Offshore the central North Slope, Eni Petroleum's Nikaitchuq field will go into production from the Brookian sands of the Schrader Bluff formation.

**Point Thomson**

On the Beaufort Sea coast, just west of ANWR, ExxonMobil has been engaged in the development of the large Point Thomson gas condensate field, despite an on-going legal tussle with the State of Alaska over termination of the Point Thomson leases. The company has now completed the drilling of a production well and injection well as part of a \$1.3 billion gas cycling project at the field, with initial production of perhaps 10,000 barrels of gas condensate per day slated to start by year-end 2014.

The Alaska Department of Natural Resources had terminated the Point Thomson unit in late 2006 and subsequently taken back the associated leases because ExxonMobil had not developed the field in the 30 years or so since the field was discovered. DNR subsequently reinstated two of the leases, on condition that ExxonMobil proceeded with the development drilling. However, the status of the unit is still the subject of litigation.

ExxonMobil has started applying for a right of way for a 22-mile pipeline for delivering condensate from Point Thomson to the Badami pipeline, a pipeline that in turn connects farther west to the Endicott pipeline and, hence, to the trans-Alaska oil pipeline. The extension of the oil pipeline infrastructure in the

*continued on page 80*

If Alaskans spoke of a "Big 4" instead of a "Big 3" Chevron would be a contender for the extra spot, but as it stands the California major is often overshadowed by companies that operate more units or run larger exploration campaigns in Alaska. Chevron arrived in Alaska more than 100 years ago, and now holds minority shares in the Prudhoe Bay and Point Thomson units, leases in the Arctic National Wildlife Refuge, a share of the trans-Alaska oil pipeline and a large oil and natural gas operation in the Cook Inlet basin. The company, along with its affiliate Union Oil Co. of California, owns some 176,000 acres in Alaska, and produces 14,000 barrels of oil and 99 million cubic feet of gas per day.

A 2005 acquisition of Unocal re-energized Chevron's exploration efforts in northern Alaska, primarily at the White Hills prospect in the central North Slope, just south of the Kuparuk River unit. Chevron won't discuss White Hills publicly, but state filings show the company drilled five wells in 2008 and 2009, and relinquished the southern two-thirds and the northern tip of the prospect in 2010. Chevron is now analyzing that refined prospect, but hasn't announced future plans.

**NAME OF COMPANY:** Chevron Alaska  
**HEADQUARTERS OF PARENT COMPANY:** San Ramon, Calif.  
**HEADQUARTERS IN ALASKA:** Anchorage  
**TOP EXECUTIVE IN ALASKA:** John Zager, general manager, Alaska  
**MAIN ALASKA TELEPHONE:** 907-276-7600  
**COMPANY WEBSITE:** www.chevron.com



JOHN ZAGER

While Chevron appeals a state ruling rejecting a recent plan of development. Meanwhile, the company is focusing on development work at its legacy fields and maintaining its aging infrastructure, like the Anna platform it shut in for several months due to corrosion concerns and the 25 wells from the lighthoused Baker platform that Chevron plans to plug and abandon.

**Current exploration focus:**

**Northern Alaska:** Chevron is not planning any exploration work this year, but continues to analyze data gathered at its White Hills oil and gas prospect south of Kuparuk River.

**Cook Inlet:** Chevron said it plans to focus on cost-effective development in its producing fields in 2011, including work planned in the coming year at the Swanson River unit, Beluga River unit, Ninilchik unit and the Grayling Gas Sands in MacArthur River field.

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Badami-Point Thomson area might open up new exploration and development opportunities to the east of Prudhoe Bay, an area where there are other known oil pools.

Southwest of Badami, and 10 miles southeast of Prudhoe Bay, Anadarko, with partners BG Alaska and Arctic Slope Regional Corp., drilled its Jacob's Ladder well in 2007 and 2008 to a depth of 14,400 feet, to test an unusual but promising Ellesmerian prospect, somewhat equivalent to the Lisburne field at Prudhoe Bay. Unfortunately the well proved to be a dry hole.

### White Hills

In the winter of 2007-08 Chevron started a multiyear exploration drilling project in the White Hills region of the central North Slope, south of the Kuparuk River field, near the Dalton Highway. The company drilled three White Hills wells in 2008 and two more wells in 2009, saying that it was drilling for both oil and gas. None of the wells penetrated depths below about 5,000 feet.

The records from the 2008 drilling have been published by the Alaska Oil and Gas Conservation Commission and do not indicate that any of the wells drilled that year encountered oil or gas; the records include shallow hazards reports stating that the discovery of natural gas was the primary drilling objective, with the wells penetrating the Sagavanirktok Group, and the Prince Creek, Ugnu and West Sak or Schrader Bluff formations, of the Brookian sequence on prospective geologic structures.

In February 2010 Chevron relinquished 41 of its White Hills leases, comprising approximately the southern two thirds of the company's acreage in the region. And in August 2010 the company dropped five more leases in the northern tip of the region. The company had previously indicated that it intended to even-

tually drill more wells in the northern White Hills area.

### Exploring through technology

BP, one of the first companies to explore on the North Slope, announced in 2001 that it was withdrawing from traditional exploration activities in Alaska, electing instead to develop new oil reserves by exploiting new technologies in existing oil fields, a strategy that it has termed "exploring through technology." Essentially the company substitutes the risk of trying unproven new technologies to exploit known resources for the risk involved in seeking unknown new fields.

In particular, the company has been pursuing this strategy as operator of the huge Prudhoe Bay field — with perhaps 25 billion barrels of original oil in place, just a small percentage increase in oil recovery from the field's massive subterranean reservoirs can amount to the production of a major amount of useful product that would otherwise remain underground and that could amount to the volume recoverable in total from a modest size field elsewhere.

Techniques that BP has been using to increase oil recovery at Prudhoe Bay include precision directional and coiled-tubing drilling; the use of high-tech enhanced oil recovery techniques; and the use of 3-D and 4-D seismic surveying.

### Viscous oil

And both BP and ConocoPhillips have been using techniques such as the drilling of horizontal wells and multilateral wells — multiple wells branching out from a single vertical well bore — to render viable the production of thick viscous oil from the shallow Brookian, West Sak and Schrader Bluff reservoirs above the Prudhoe Bay and Kuparuk River fields.

BP has also been researching the possible production of heavy oil — oil too thick to flow by itself down a pipeline — and has conducted some initial tests of a technique called "cold heavy oil production with sand," or CHOPS, at a well pad in the Milne Point field, extracting oil with a consistency of chocolate syrup from the shallow Brookian Ugnu formation. In March 2010 the company announced that it was completing the construction of a \$100 million facility on the Milne Point S-Pad, to test ways of producing heavy oil from the Ugnu. The company



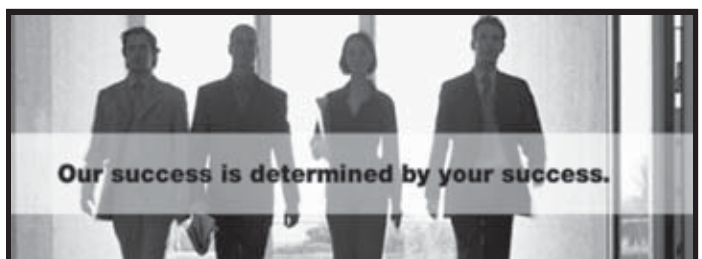
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had completed four wells, including one horizontal well, at S-Pad for the tests, BP said.

Another possibility for the future, especially if a North Slope gas line is constructed, is the production of natural gas from methane hydrate, a solid compound in which methane molecules are trapped within the crystalline structure of frozen water. Hydrates are known to occur in large quantities around the base of the permafrost zone below the central North Slope. Methane is the main component of natural gas.

In 2007, as part of a joint industry, university and government gas hydrate research project, with some funding from the U.S. Department of Energy, BP successfully drilled the Mount Elbert gas hydrate stratigraphic test well at Milne Point, with the research team recovering gas hydrate samples and conducting some tests on the characteristics of the hydrates around the well bore. The team has since been evaluating possible sites for a gas hydrate production test, recognizing that much work remains to be done to determine whether it will be possible to produce gas from hydrates on a commercial basis.

ConocoPhillips is engaged in a parallel project with DOE, evaluating the potential to produce natural gas by injecting waste carbon dioxide into gas hydrate deposits. At the west end of the North Slope DOE and the North Slope Borough had been investigating the possibility that gas hydrates are contributing to production from gas fields near the city of Barrow, but DOE has pulled its funding for that project.

## National Petroleum Reserve-Alaska

The National Petroleum Reserve-Alaska, or NPR-A, consists of a 23 million-acre region at the western end of northern Alaska between the Beaufort Sea and Chukchi Sea coasts and the northern margin of the Brooks Range. The northern part of NPR-A lies within the coastal plain while the southern part straddles the Brooks Range foothills belt.

People have long known of the petroleum potential of this huge land area — surface oil seeps and oil-stained rocks provide evidence of active petroleum systems. In 1923 President Harding established the area, then known as the Naval Petroleum Reserve No. 4, as a potential source of oil supplies for the U.S.

Navy. When jurisdiction over the reserve was transferred to the U.S. Bureau of Land Management in 1976, the name of the reserve was changed to the National Petroleum Reserve-Alaska.

The U.S. government conducted two exploration programs in NPR-A, one that led to several years of drilling by the U.S. Navy following World War II and one coordinated by the U.S. Geological Survey in the 1970s and 1980s. The earlier of these campaigns focused on exploring for strategic quantities of oil and gas, while the later phase went to greater lengths to develop a detailed understanding of the geology of the area.

These programs resulted in more than 14,000 line miles of seismic surveys, 126 exploration wells and the 1946 discovery of a modest-sized oil field at Umiat on the Colville River. In 1985 ARCO drilled the Brontosaurus well to test an Ellesmerian prospect but the well proved dry.

The northeastern edge of NPR-A lies just south of the western extension of the Barrow Arch structure associated with the Prudhoe Bay field, but the huge Colville basin — filled with sediments of the Brookian sequence, folded and thrust-faulted along its southern side, adjacent the Brooks Range — dominates the geology of NPR-A.

### 1999 lease sale

In the northernmost part of NPR-A a Beaufortian play associated with the Alpine field in the neighboring Colville River Delta has proved a fruitful line of exploration following the advent of modern NPR-A leasing with a lease sale in 1999. The 1999 lease sale covered just the northeastern part of the reserve and resulted in ARCO, Anadarko, Phillips Petroleum and BP all ending up with acreage positions. ARCO and Phillips both later became part of what is now ConocoPhillips.

Although Anadarko subsequently drilled its own Altamura No. 1 exploration well in northeastern NPR-A, the company has conducted most of its northern NPR-A exploration in partnership with ARCO and later ConocoPhillips, with ConocoPhillips as operator.

That partnership conducted drilling in the extreme northeastern part of the reserve, relatively near the Colville River and the Alpine field, but leases from the 1999 sale also hosted more

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**HEADQUARTERS OF PARENT COMPANY:** Wichita, Kan.  
**HEADQUARTERS IN ALASKA:** Anchorage  
**TOP EXECUTIVE IN ALASKA:** Bo Darrah, president and CEO  
**MAIN ALASKA TELEPHONE:** 907-339-9965 • **FAX:** 907-339-9961  
**COMPANY WEBSITE:** www.avcg-llc.com



arrived in Alaska in 1999, taking advantage of the Charter for Development of the North Slope, which set out terms for smaller companies to lease existing facilities. The company quickly bought up North Slope acreage, but found the economics of Arctic Alaska unsuitable for drilling. AVCG solved the problem by creating BRPC and partnering with three other independents, and today the joint venture holds 237,460 gross acres across several North Slope regions.

In 2008, the joint venture drilled two wells in Gwydyr Bay and one well in the Tofkat prospect east of Nuiqsut, finding oil at all three despite a mechanical problem that impeded testing of one well. In 2009, the joint venture laid out a development plan for Gwydyr Bay and formed the Beechey Point unit in the area, but a now-resolved lawsuit between two companies in the joint ven-

ture postponed drilling plans. This past winter, the joint venture drilled two wells. The results of the Sak River 1-A sidetrack led partner TG World Energy to relinquish some interest in the program. The remaining companies drilled the North Shore No. 3 well at Beechey Point, but did not release results. In 2011, the joint venture plans to drill the North Tarn No. 1 exploration well on leases farmed in from Eni Petroleum contiguous to the western edge of the Kuparuk River unit. Depending on partner approval, the companies could drill additional wells next year and/or shoot 3-D seismic at the Slugger prospect south of the Point Thomson unit.

#### Current exploration focus:

**Northern Alaska:** BRPC and its partners TG World Energy and Ramshorn Investments Inc. are developing the Beechey Point unit in the Gwydyr Bay area north of Prudhoe Bay; exploring at Tofkat, east of Nuiqsut; at North Tarn, contiguous to the western edge of the Kuparuk River unit; and at Slugger, a prospect south of the Point Thomson unit.

remote drilling, substantially farther west, by BP at Trailblazer in 2001 and by Phillips at Puviaq in 2003. Drilling at Puviaq, to the west of Teshekpuk Lake about halfway between the Colville River Delta and the city of Barrow, at the extreme northwest end of the coastal plain, involved staging a drilling rig on an ice pad during the summer and using tundra off-road vehicles to transport personnel and equipment.

In a second northeast NPR-A lease sale in 2002, Phillips and Anadarko flagged their continued interest in the region by dominating the sale, building onto their existing lease positions. TotalFinaElf and EnCana Oil & Gas also bought leases at that sale, while BP confirmed its withdrawal from Alaska exploration by not bidding. In 2003 BP finally sold its NPR-A acreage from the earlier lease sale. EnCana dropped its NPR-A leases in 2004, eventually pulling the plug on all of its Alaska exploration interests toward the end of that year.

#### Northwestern NPR-A

Despite litigation by environmental groups concerned about the specter of oil and gas development expanding across much of the extreme northwest of Alaska, the U.S. Bureau of Land Management held its first lease sale for the northwestern part of NPR-A in June 2004. At that sale, Anadarko, ConocoPhillips, Pioneer, Petro-Canada and Fortuna Exploration all purchased leases. Fortuna, the Alaska subsidiary of Talisman, the Canadian independent that had already farmed into Total's NPR-A acreage, would later change its name to FEX.

But, following disappointment at its remote Caribou 26-11 well, jointly drilled with Fortuna in February 2004, Total appeared to lose interest in NPR-A, choosing not to bid in the June 2004 lease sale and assigning some of its leases to FEX.

The ConocoPhillips and Anadarko partnership continued its remote NPR-A exploration program by drilling two wells at the Kokoda prospect, at the end of a 70-mile ice road, in 2005. And in 2005 Anadarko told Petroleum News that its strategy in these remote areas was the discovery of large "anchor" fields that would be viable to develop and then form hubs for the development of smaller fields.

Also in 2004 and 2005, Pioneer signed NPR-A exploration agreements with ConocoPhillips and Anadarko, agreements that involved the acquisition by Pioneer of a 20 percent working interest in NPR-A acres and adjacent offshore acreage, additional to Pioneer's existing NPR-A holdings. In early 2007 ConocoPhillips, in partnership with Pioneer, drilled two NPR-A wells, both a long way from infrastructure: the Noatak No. 1 well, just north of Kokoda, and the Intrepid No. 2, south of Barrow, at the far western end of the North Slope, about 200 miles from the oil infrastructure of the Alpine field.

But in May 2007 ConocoPhillips declared both the Noatak

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and Intrepid wells to be noncommercial.

## FEX

In the winter of 2005-06 FEX completed the first of its NPR-A exploration wells, at a remote site some 140 miles west of Prudhoe Bay, using a Nabors drilling rig staged at Smith Bay on the Beaufort Sea coast. The company also shot some 3-D seismic on its leases.

In July 2006 the U.S. Court of Appeals for the 9th Circuit affirmed a 2005 decision by the U.S. District Court for Alaska to reject the appeal against the June 2004 northwest NPR-A lease sale, thus clearing the way for oil and gas drilling in that part of the reserve. In September of that year, however, the District Court put a halt to a planned northeast NPR-A lease sale, following an appeal by a number of environmental groups against that sale. The appeal, which was also supported by the North Slope Borough, focused on a proposal to open for leasing an environmentally sensitive area around Teshekpuk Lake, an area thought to be prospective for oil and gas because of its proximity to the Barrow arch, the geologic feature associated with most of the operational northern Alaska oil fields.

BLM did proceed with a northwestern NPR-A lease sale in September 2006, with FEX and Petro-Canada picking up substantial acreage. ConocoPhillips and Anadarko also bought some leases in the southern and central part of the northwestern planning area.

In the winter of 2006-07, in a two-rig program involving the use of Doyon's Arctic Wolf rig, transported from Prudhoe Bay, as well as the rig staged at Smith Bay, FEX drilled three wells in northwestern NPR-A, eventually suspending two of the wells and plugging and abandoning the third, Amaguq-2, which the

company said was "subcommercial given current infrastructure."

## 300 million to 400 million barrels

But the company also revealed that it had encountered more than 225 feet of net hydrocarbon-bearing sandstones in several formations in two wells it had drilled and suspended, with log analysis indicating "300-400 million barrels" net to FEX — FEX had a 60 to 80 percent working interest in the leases with Petro-Canada.

But in 2007 FEX, citing high drilling costs in remote NPR-A locations and frustration with the stymied NPR-A lease sale program, declared a pause in its NPR-A drilling, choosing instead to shoot some new 3-D seismic and spend some time evaluating its project areas.

In September 2008, BLM finally held a new lease sale for northeastern NPR-A, having withdrawn from the sale area the contentious land north and east of Teshekpuk Lake. ConocoPhillips, Anadarko, Petro-Canada, FEX and newcomer Petro-Hunt LLC all picked up NPR-A acreage in the sale. Petro-Hunt later relinquished its leases, as a consequence of the crash in oil prices later in 2008.

In January 2009 a senior Talisman executive told the Alaska Support Industry Alliance that FEX would not drill again in NPR-A until 2011, at the earliest. And in a March 2010 financial filing with Canadian regulators, Talisman indicated that it wanted to sell its FEX leases in northern Alaska. In the summer of 2010 FEX relinquished all of its state onshore leases, amounting to about 63,110 acres in the Umiat area, and also dropped its 94,135-acre lease position, straddling Harrison Bay, offshore the

*continued on next page*



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northeastern corner of the NPR-A.

But meantime, following a lack of success in ultra-expensive, remote wells such as the Kokoda wells, Noatak and Intrepid, ConocoPhillips, Pioneer and Anadarko dropped 300,000 acres of NPR-A leases in September 2007. ConocoPhillips dropped additional acreage near Barrow in 2008, a move that reflected the company's clear intent to consolidate and move forward with exploration and development of prospects immediately west of the Alpine field.

And in a September 2007 media briefing, Pioneer President and Chief Operating Officer Timothy Dove said that, following disappointing exploration drilling results both in the central North Slope and in NPR-A, Pioneer was suspending its Alaska exploration drilling program, focusing instead on developing its Beaufort Sea Ooguruk field and on investigating potential production from the Cosmopolitan prospect in the Cook Inlet.

### Alpine play

Meantime ConocoPhillips and Anadarko continued to progress their work on the discovery and delineation of some oil pools in northeast NPR-A, similar to the Alpine field in the adjacent Colville River Delta.

In January 2008 the companies formed the Mooses Tooth unit, with ConocoPhillips as operator, in a move that protected the companies' NPR-A lease positions in an area by then known to contain five distinct oil discoveries at Lookout, Mooses Tooth, Rendezvous, Spark and Altamura. And in the winter of 2008-09 ConocoPhillips drilled two new wells, the Grandview No. 1 and Pioneer No. 1, in the new unit, as part of a continuing strategy to better understand and eventually develop the Alpine-style play in northeastern NPR-A.

In NPR-A lease sales in 2008 and 2010 ConocoPhillips bought leases that consolidated its position around the Mooses Tooth unit, while in the 2008 sale Anadarko and Petro-Canada extended their lease positions around a natural gas play near Umiat — that play is discussed in the Brooks Range foothills section of this publication.

In May 2009, having just completed the drilling of the Pioneer No. 1 well, ConocoPhillips announced test results for that well, and for another Greater Mooses Tooth well, the Rendezvous No. 2, drilled in early 2001. The wells tested over a range of 500 barrels per day to 1,300 barrels per day of light oil, and an average natural gas production rate of about 1.5 million cubic feet per day for each well.

Then in August 2009, faced with the expiration of dozens of NPR-A leases, ConocoPhillips worked out a deal with the Bureau of Land Management to preserve some leases by expanding the Mooses Tooth unit and forming an adjacent unit called Bear Tooth. The Mooses Tooth unit now stands at 164,014 acres, with a commitment by ConocoPhillips to spud a new exploration well by the third quarter of 2015. The Bear Tooth unit covers 105,655 acres, with a commitment to test an existing well, the Scout No. 1, and drill a new well by June 1, 2012.

### CD-5 impasse

Meantime, ConocoPhillips and Anadarko moved forward with the permitting of their CD-5 Alpine West satellite field, located about halfway between the Mooses Tooth unit and the Alpine field. Alpine West, which would be the first field to go into production in NPR-A, would also represent continued satellite field development associated with the Alpine field, following the earlier development of the Fiord, Nanuq and Qannik Alpine satellites.

But the U.S. Army Corps of Engineers has refused to issue a permit for the construction of a bridge and pipeline across the Nigliq channel of the Colville River, saying that there are less environmentally invasive alternatives such as the use of horizontal directional drilling to run a pipeline under the channel. The U.S. Environmental Protection Agency had recommended permit denial because it said that the Colville Delta is an aquatic resource of national importance.

ConocoPhillips and Anadarko have said that an underground pipeline poses an unacceptably high pipeline corrosion risk. The Corps of Engineers is reviewing its decision, with the U.S. Department of the Interior also investigating the situation.

And so, NPR-A exploration is currently somewhat in a state of limbo, perhaps waiting for upward signals from global oil prices to justify the search for oil in the more remote parts of the region while also waiting for resolution of the impasse over CD-5 access in northeastern NPR-A.

Meantime, in the summer of 2010, BLM announced that it was starting the development of a new activity plan and associated environmental impact statement for the whole of NPR-A. The agency says that it is committed to promoting oil and gas development in the reserve and that the new plan will remove current rule and procedure inconsistencies between previous planning areas. BLM plans to develop its new plan within two years.

## Brooks Range foothills

The Brooks Range foothills, also referred to as the North

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Slope foothills, extend in a broad east-west swath of territory north of the Brooks Range, from the Chukchi Sea to the western edge of the Arctic National Wildlife Refuge. East of the Canning River the foothills belt becomes less distinct and trends north and east to the Canadian border and under the Beaufort Sea.

The foothills and the northern front of the Brook Range afford excellent opportunities to examine surface outcrops of rocks that lie deep underground elsewhere, and in recent years the region has become a subject for detailed investigation by a team from the Alaska Division of Geological and Geophysical Surveys in collaboration with the Alaska Division of Oil and Gas, USGS and oil industry geologists. Near the Dalton Highway the team found potential reservoirs and potential oil and gas source rocks equivalent to some of the more prolific sources on the North Slope. Oil stained sands in the area provide tantalizing evidence that oil migrated through the rock units. Geologists have interpreted one oil-stained location about 40 miles south of Umiat as a former oil field now breached by erosion.

The DGGS team has also found substantial outcrops of Ellesmerian carbonate rocks with reservoir potential.

Folding of the Brookian strata in the foothills gives rise to the potential for structural traps that are unlikely to exist farther north. This Brookian structural play is associated with the Umiat oil field. Several other small accumulations have been discovered in the fold belt trend of NPR-A, but they contain mostly gas.

In fact the relatively high thermal maturity and leaner organic content of Brookian rocks in most of the foothills area points to the formation of natural gas rather than oil — most people consider the Brooks Range foothills to be a gas prone province. However, evidence such as the Umiat oil field, oil-

stained rocks at the surface and the discovery of at least some oil-prone source rocks in the region hints at the existence of some oil, perhaps derived in part from Ellesmerian or Beaufortian source rocks.

## Umiat

The 1999 BLM northeastern NPR-A lease sale, although triggered by an interest in exploration west of the Colville River delta, opened the possibility of oil and gas leasing around the Umiat oil field, in the southeastern corner of the lease sale area. Low oil prices at that time discouraged Umiat development, but as prices started to climb a few years later the field caught the attention of Texas-based Renaissance Alaska LLC, spurring Renaissance to progressively buy into the relevant federal and state leases to establish a lease position over the field.

In February 2008 Renaissance deferred an initial plan to drill seven or eight appraisal wells in the Umiat structure, electing instead to “de-risk” field development with a 3-D seismic survey. In September 2009 the company told Petroleum News that it was waiting for evidence of sustained high oil prices before making a decision on whether to proceed with development drilling at the field. However, the company may drill a shallow well as soon as the winter of 2011-12, to test flow rates from the field.

A new assessment by Ryder Scott Co. had indicated that the two main reservoir sands in the field may contain about 250 million barrels of economically recoverable light, sweet 37 API oil, said Jim Watt, Renaissance president and CEO. There may be more than 700 million barrels of oil in place in those horizons and, when added to other oil in the shallow sands that have

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After a quick windup in Alaska, FEX now appears to be slowly winding down. The local subsidiary of Canadian independent Talisman is responsible for some of the most remote wildcats recently drilled in Alaska. Talisman arrived on the North Slope in 2003 and began drilling the following year as FEX, both alone and in partnership with the French company Total. Searching in the far western lands of the National Petroleum Reserve-Alaska, FEX needed big finds to justify developing the remote regions, far from the nearest infrastructure. FEX announced a find in 2007, but executive changes at Talisman put a question mark on FEX's activities. Alaska made the cut in May 2008, and FEX began ramping up operations again using



RICHARD GARRARD

NAME OF COMPANY:  
FEX-Talisman Energy  
HEADQUARTERS OF PARENT  
COMPANY: Calgary  
TOP EXECUTIVE IN ALASKA:  
Richard Garrard, geosciences manager for FEX  
MAIN ALASKA TELEPHONE: 907-644-4429 • FAX: 907-644-4892  
COMPANY WEBSITE: www.talisman-energy.com



a slate of newer seismic data. In March 2010, though, the company suggested that 1 million net acres in the NPR-A were up for sale. This summer, FEX dropped 94,135 offshore state acres in Harrison Bay and a prospect southwest of White Hills that contained BP's 1 Itkillik

Unit well. FEX still currently holds some 108,000 acres in state leases, a cluster of offshore acreage in Smith Bay.

**Current exploration focus:**

**Northern Alaska:** FEX does not appear to be planning exploration work for Alaska, having announced that 1 million net acres of its NPR-A acreage are up for sale.

given rise to some well known oil seeps at Umiat, there may be more than 1 billion barrels of oil in place in the field, Renaissance thinks.

Renaissance is in the process of developing a business plan for Umiat, a plan that envisages the delivery of oil by pipeline to pump station 2 of the trans-Alaska oil pipeline. However, because the deepest oil at Umiat is only about 1,400 feet below the surface, the oil will be produced at temperatures of just 28

to 32 F, low temperatures that will present some unusual production challenges — Renaissance envisages pumping the oil, cold, down the export pipeline, rather than trying to heat up the oil for shipment.

**Gas exploration**

Apart from the work at the Umiat oil field, the gas-prone nature of the foothills petroleum geology, the known existence of some gas fields near Umiat and some significant moves toward the development of a natural gas export pipeline from the central North Slope have together triggered more of an interest in gas exploration in the foothills.

Anadarko has for more than a decade been the leading figure in this play.

In August 1998, the company signed an exclusive exploration agreement with Arctic Slope Regional Corp., granting Anadarko exploration rights for up to 3.3 million acres in the foothills region. Anadarko later brought in Alberta Energy Co. subsidiary AEC Oil & Gas (subsequently to become EnCana) and BP as one-third partners. Anadarko retained operatorship.

Anadarko said that it was interested in exploring for both oil and natural gas in the foothills, although the company has increasingly focused on natural gas in the region.

In state foothills lease sales held in 2001 and 2002, a partnership between Anadarko and EnCana added state acreage to their foothills portfolios, while EnCana purchased some leases in BLM's June 2002 NPR-A lease sale.

But in 2003 BP sold its foothills lease position to Anadarko as part of a BP strategic move to exit Alaska exploration. In early 2005 Anadarko established a new foothills partnership with Petro-Canada. Then, following EnCana's departure from Alaska in 2005, Anadarko found another foothills partner, BG Group, to buy a one-third interest in the acreage held by Anadarko and Petro-Canada.

In the 2006 state areawide lease sale for the foothills region, Anadarko, Petro-Canada and BG jointly purchased additional acreage. Anadarko and Petro-Canada also bought some foothills acreage in the 2008 northeast NPR-A lease sale.

Anadarko and its partners had conducted seismic surveys in

their foothills acreage but had been holding back on drilling, looking for a reasonable possibility of the development of a North Slope gas pipeline for the export of foothills gas. In 2007, with the passing of the state's Alaska Gasline Inducement Act, or AGIA, momentum toward gas pipeline development grew, thus upping the possibility of foothills gas ultimately becoming marketable.

During the winter exploration season of 2007-08, Anadarko, with partners BG and Petro-Canada, used Nabors rig 105-E to drill the Gubik No. 3 well and start drilling the Chandler No. 1 well, the first wells in northern Alaska to specifically target natural gas. Then, having over-summered the rig at Chandler on an insulated ice pad, Anadarko completed the drilling of the Chandler well in the winter of 2008-09.

Both wells sit near Umiat, near or at the known Gubik gas field, in Arctic Slope Regional Corp. land just outside the eastern boundary of NPR-A. Discovered by the U.S. Navy in 1951, Gubik is thought to hold some 600 billion cubic feet of recoverable gas in the Tuluva and Nanushuk formations.

Chandler No. 1, about six miles southwest of Gubik No. 3, was drilled to about 10,200 feet; Gubik had a total depth of about 4,300 feet. According to Petro-Canada filings with the U.S. Securities and Exchange Commission, the Gubik No. 3 well tested at rates up to 15 million cubic feet per day of natural gas.

Also in the winter of 2008-09, Anadarko used the Doyon Arctic Fox rig to drill the Wolf Creek No. 4 well, at the site of another known gas accumulation in federal land inside NPR-A, about 40 miles west of Umiat.

Anadarko refers to the system of gas fields that it is evaluating as the "Gubik Complex."

### Shipping the gas

The question of how companies exploring for gas in the Umiat area might eventually ship their gas to market depends in part on whether and when a main gas export line from the North Slope might be constructed — an obvious option would be to run a feeder gas line from Umiat over to the North Slope line. However, another option being considered both by the state through the Alaska Gasline Development Corp. and by Enstar Natural Gas Co., the main South-central Alaska gas utility, is a "bullet line" that would feed gas direct from the

foothills into the Anchorage area, to supplement or replace the dwindling supplies of Cook Inlet gas for utility and industrial use.

The Alaska Natural Gas Development Authority has also proposed a spur line into the Anchorage area from a future North Slope gas line, and this type of spur line could also feed foothills gas into Southcentral Alaska.

Mark Hanley, Alaska public affairs manager for Anadarko, told Alaska legislators in February 2009 that gas was unlikely to be available to flow to market from any foothills gas field before 2016. If a North Slope export gas pipeline is constructed,

that line would not come into operation until several years after that.

Renaissance has suggested that its development of the Umiat oil field, together with the Anadarko-led gas development in the area, could enable the sharing of environmental studies and pipeline or road rights of way among multiple projects, thus reducing project costs and perhaps establishing an Umiat bridgehead for further exploration and development in that part of NPR-A.

And the state is considering building a 75-mile gravel road from the Dalton High-

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Savant has spent its entire tenure in Alaska focused on the eastern North Slope. The local subsidiary of Denver-based independent Savant Resources picked up leases in Foggy Island Bay in 2006. Savant



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 CHIEF EXECUTIVE OFFICER OF PARENT COMPANY: Pat Shaw  
 TOP EXECUTIVE IN ALASKA: Greg Vigil, executive vice president  
 COMPANY TELEPHONE: 303-592-1905



in the works, justified a plan to bring the Badami unit back on-line in October. Petroleum News sources said Savant is talking to potential drilling partners for the eastern North Slope, but company executives would not con-

firm the information. Savant does not have firm plans for development drilling in 2011, but also has not ruled it out. Savant Alaska holds nearly 11,500 acres of state onshore and offshore leases in its own right.

called the oil prospect Kupcake and drilled an exploration well from an ice island in early 2008, but the well failed to uncover hydrocarbon resources worth pursuing. Savant re-emerged in late 2008, though. In a partnership with BP and Arctic Slope Regional Corp., the company planned to drill an exploration well at Badami, BP's long-troubled eastern North Slope unit. Savant finished the B1-38 well at the Red Wolf prospect this past winter, finding oil, and drilled a new horizontal sidetrack to improve production at known reservoirs. Those wells, along with four others

Current exploration focus:

**Northern Alaska:** Savant continues to explore and develop the Badami unit in the eastern North Slope to improve production at known fields and develop new reservoirs.

way to Umiat, to support oil and gas development in the Umiat area. In 2010 the state allocated \$8 million to environmental studies for the road route, which could potentially include a pipeline right of way.

But the acquisition of Petro-Canada by Suncor Energy in August 2009 threw another unknown into the foothills gas development equation: Suncor sees oil sands as its prime growth area and at the time of the Petro-Canada acquisition had been planning to sell some of its natural gas assets. However, Suncor remains a partner in Anadarko's foothills exploration venture and has not yet stated its intentions with regard to Alaska gas exploration.

In November 2009 Anadarko said that it was still evaluating the results of its foothills drilling and that it would not drill any new wells in the foothills region in the winter of 2009-10. And in the summer of 2010 the company dropped a fairway of 61 state leases in the extreme south of the foothills region, saying that it was focusing its efforts on the Gubik area. However, the company also said that it did not expect to carry out any drilling in the foothills area during the 2010-11 winter and that it was putting together a multiyear plan while waiting to see what will happen with respect to proposals for gas lines from northern Alaska.

## Beaufort and Chukchi seas outer continental shelf

A lack of infrastructure, harsh weather and extensive sea ice have long presented formidable barriers to anyone interested in exploring for oil in the remote waters of the Beaufort and Chukchi seas. Yet, with geology that forms a continuation of the prolific onshore petroleum systems of the North Slope, the Arctic outer continental shelf of Alaska presents some tantalizing opportunities.

In fact, exploration in the Beaufort Sea dates back to the early years of central North Slope development and exploration, with the Endicott field being discovered in 1978.

A total of 30 Beaufort Sea exploration wells have targeted

prospects in a range of plays from Ellesmerian to Brookian. The 202 million-barrel Northstar oil field (formerly known as Seal Island) straddling the edge of state nearshore waters just north of Prudhoe Bay went into production in 2001.

BP is now in the process of developing the Liberty field, on the outer continental shelf about 15 miles east of Prudhoe Bay, using record-breaking ultra-extended-reach drilling from the satellite drilling island at the Endicott field. The Liberty reservoir is in the same Ellesmerian Endicott group that contains the reservoir for Endicott.

By using extended-reach drilling at Liberty, BP is avoiding the need for an offshore island and a connecting pipeline to the mainland. However, drilling extended-reach wells into reservoir targets some 8 miles from the surface drilling site has involved the construction of the world's most powerful land-based drilling rig, built by Parker Drilling Co. at a cost of more than \$200 million. Other innovative technologies required at Liberty include the use of a new steel alloy for the drill pipe.

The Parker rig is now on site at Endicott but BP has postponed the start of development drilling into 2011, pending a new BOEMRE environmental review of the project following BP's Deepwater Horizon disaster in the Gulf of Mexico.

According to BOEMRE there are three other known undeveloped fields in the Beaufort Sea: the 100 million- to 200 million-barrel Sivulliq field (previously known as Hammerhead), the 160 million- to 300 million-barrel Kuvlum field and the 12 million-barrel Sandpiper field. Sivulliq and Kuvlum are reservoirs in faulted traps in Brookian sediments north of the western end of ANWR while Sandpiper occupies the Sadlerochit reservoir in a series of fault blocks farther northwest, on the same trend as Northstar.

### Chukchi Sea

Exploration in the Chukchi Sea has been sparser than in the Beaufort.

Between 1989 and 1991 a group of companies led by Shell did drill five exploration wells in the Chukchi, focusing on structures with similar features to the North Slope oil fields. One well, the Klondike well, drilled into a 1,000-foot section of rocks

Shell got close, but not close enough this year. Since coming back to the state in 2005, years of lawsuits have kept the Dutch major from drilling. The company resolved those efforts in 2010, only to see its exploration efforts



PETE SLAIBY

stalled again by a federal moratorium in the wake of the Deepwater Horizon oil spill in the Gulf of Mexico. Shell arrived in Alaska in the 1950s, exploring the Alaska Peninsula and the North Slope. It brought the Middle Ground Shoal field into production in Cook Inlet in the 1960s, but sold the field in 1998.

Shell returned to Alaska in 2005, picking up acreage in the Beaufort Sea and later a few state leases on the Alaska Peninsula. In early 2008, Shell bid \$2.1 billion for 275 blocks in the Chukchi Sea, including areas where the company drilled in 1989 and 1990. In early 2009 Shell gave up its Alaska Peninsula acreage. Legal

NAME OF COMPANY: Shell  
 HEADQUARTERS OF PARENT COMPANY: The Hague, Holland  
 HEADQUARTERS IN ALASKA: 3601 C St., Suite 1334, Anchorage, Alaska 99503  
 TOP EXECUTIVE IN ALASKA: Pete Slaiby, vice president  
 MAIN ALASKA TELEPHONE NUMBER: 907-770-3700  
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challenges over its Beaufort Sea plans led Shell to pare down its initial exploration program in the area. In spring 2010, Shell began mobilizing equipment to drill five wells in the Beaufort and Chukchi seas. With the federal review of offshore drilling, though, those plans are

on hold until at least 2011, and could be delayed even further if Shell doesn't get approval by early next year.

#### Current exploration focus:

**Northern Alaska:** Shell is focused on Alaska's outer continental shelf, and hopes to drill in the Sivulliq and Torpedo prospects on the west side of Camden Bay in the Beaufort Sea, and in the Burger, Crackerjack and Southwest Shoebill prospects in the Chukchi Sea in summer 2011. Both programs, though, require the approval of the federal government.

correlative to the Sadlerochit group that includes the main reservoirs at Prudhoe Bay. Unfortunately, this well found that the Sadlerochit under the central to southern part of the Chukchi consists mainly of shale rather than reservoir-quality sandstone.

But all of the wells encountered some hydrocarbons and one well, the Burger, found natural gas in a Kuparuk-equivalent sandstone reservoir 25 miles in diameter. BOEMRE estimates this accumulation contains somewhere between 8 trillion and 27 trillion cubic feet of recoverable gas and between 31 million and 1,700 million barrels of condensate, with most likely values of about 14 tcf of gas and 724 million barrels of condensate. The Klondike well found very thick Triassic source rocks, largely equivalent to the prolific Shublik formation of the North Slope. Several of the wells encountered thick, high-quality reservoir rocks: 575 feet of Permian sandstone in the Diamond well and 540 feet of Paleocene sandstone in the Popcorn well.

A future exploration program in the Chukchi probably needs to focus on looking at the area on its own merits, rather than trying to find Prudhoe Bay lookalikes. For example, there may be as much as 20,000 feet of untested stratigraphic section below the deepest rock units drilled in the 1990s.

And the need for the oil majors to find new oil reserves in increasingly challenging places, in the face of continuing world oil demand and the maturing of existing oil basins, appears to be driving an increasing interest in offshore Arctic exploration.

In particular, sustained high oil prices in 2005-06, coupled with forecasts of continued upward price pressure and the emergence of new offshore exploration and development technologies, triggered new moves toward OCS exploration. Shell led the charge in the Beaufort Sea with its purchase of a broad swath of leases, including the Sivulliq field, in the MMS 2005 Beaufort Sea lease sale. ConocoPhillips also purchased a substantial lease position in that sale.

Shell and ConocoPhillips shot 3-D seismic in the Chukchi Sea in preparation for a February 2008 MMS lease sale, where Shell was top bidder on 275 blocks for \$2.1 billion and Cono-

coPhillips was runner-up with high bids of \$506 million on 98 tracts. Repsol, Statoil and Eni were next in line.

A cluster of mega-bids in the Chukchi sale signaled interest by Shell and ConocoPhillips in the major Klondike and Burger structures that had been drilled in 1989 and 1990.

#### Shell in the Beaufort

Following the 2005 Beaufort Sea lease sale, Shell planned to start its offshore drilling program in the summer of 2007, with two drilling vessels, the Kulluk and the Frontier Discoverer, earmarked to drill three wells at Sivulliq as the first phase of an exploration plan that would involve drilling three to four wells per year until 2009.

The company assembled a small fleet of vessels for its Beaufort Sea program.

But concerns about the potential impacts of offshore industrial activities on the Arctic environment, concerns about possible impacts on subsistence hunting and concerns about the practicalities of conducting an effective response to an oil spill in the Arctic offshore have driven a spate of lawsuits that have stymied Shell's offshore drilling plans.

However, although Shell had to cancel its drilling plans in 2007 and 2008, the company conducted further 3-D seismic surveys in both the Beaufort and Chukchi seas, as well as doing some well site preparation work. Shell and Eni also conducted a 3-D seismic survey in some Beaufort Sea joint venture leases in Harrison Bay.

In addition Shell and ConocoPhillips have implemented offshore acoustic monitoring technology to detect the activities of marine mammals in the Beaufort and Chukchi seas. Shell is evaluating the use of unmanned aerial vehicles for wildlife monitoring. And the company has set up communications centers in North Slope villages, to help coordinate industrial activities with the activities of subsistence hunters.

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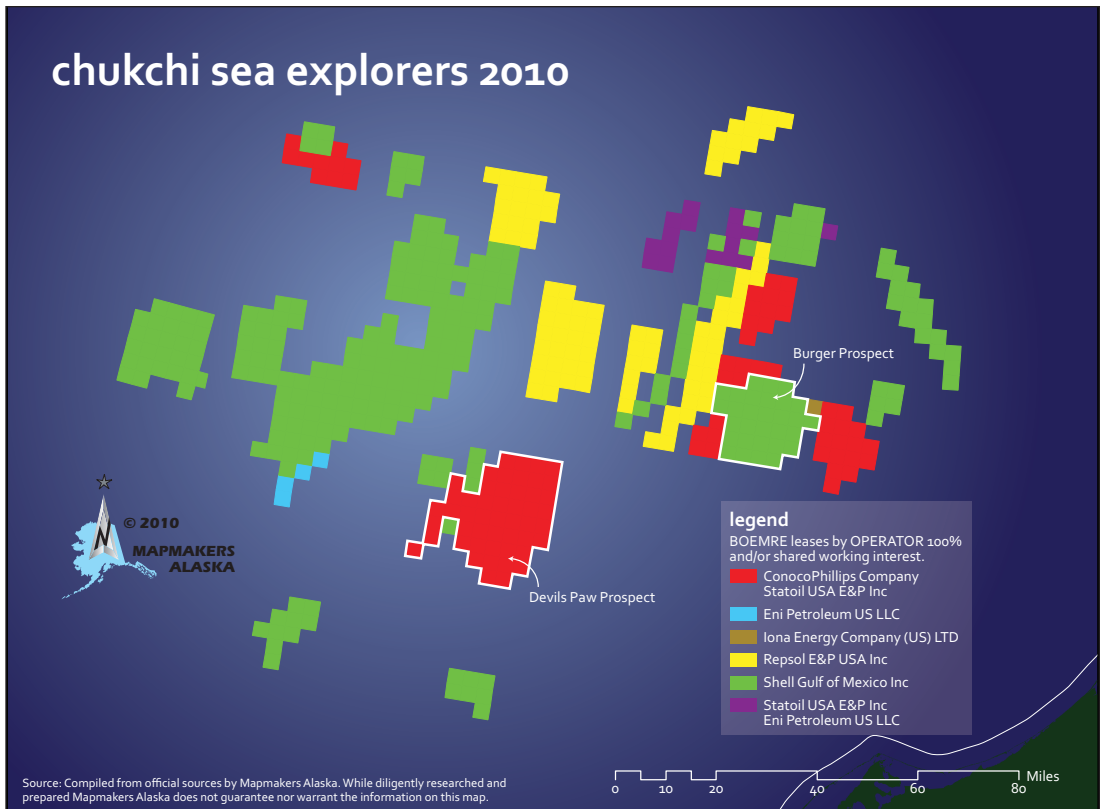
In May 2009 Shell finally withdrew its ill-fated 2007 to 2009 Beaufort Sea exploration plan, opting instead for a much-reduced plan involving the use of a single drilling vessel, the Frontier Discoverer, to drill one well in the Sivulliq prospect and one well in the nearby Torpedo prospect during the open water season of 2010. Shell upgraded the exhaust systems on the Frontier Discoverer, and the U.S. Environmental Protection Agency subsequently issued major air quality permits for the company's Arctic drilling operations. But environmental organizations and two North Slope Native organizations appealed the permits in the Environmental Appeals Board — that appeal has not yet been resolved.

Shell said that its new Beaufort Sea plan addressed concerns that were raised about the cumulative impacts of its proposed offshore activities and that the plan encompasses measures agreed to with North Slope communities to protect offshore subsistence hunting.

### Chukchi plans

Shell also planned to drill up to three exploration wells in the Chukchi Sea in 2010, in the Burger, Crackerjack, and Southwest Shoebill prospects. The Crackerjack prospect was the target of a Shell well drilled in 1990-91. The Southwest Shoebill prospect lies 20 to 30 miles southwest of Crackerjack and has not previously been drilled.

In late 2008 ConocoPhillips signaled its intention to focus its offshore exploration on the Chukchi Sea rather than the Beaufort Sea by relinquishing most of its Beaufort Sea outer continental shelf leases. In fact, the company hopes to drill in the Chukchi Sea in 2012 and has been carrying out shallow hazards



surveying and coring operations at Klondike, a prospect that the company now calls “Devil’s Paw,” where it plans to drill in 2012 drilling using a jack-up rig.

In late 2009 and early 2010 the Alaska Eskimo Whaling Commission, the Inupiat Community of the Arctic Slope, the Native Village of Point Hope and several environmental organizations appealed MMS approval of Shell’s 2010 Beaufort Sea and Chukchi Sea exploration plans. However, on May 13, 2010, the U.S. Court of Appeals for the 9th Circuit dismissed those appeals.

But by then oil was spewing into the Gulf of Mexico from BP’s out-of-control Macondo well. The unfolding disaster in the Gulf provoked Interior Secretary Ken Salazar into imposing a moratorium on deepwater drilling in the U.S. outer continental shelf and to simultaneously inform Shell that Interior would not issue any drilling permits for the Arctic outer continental shelf during 2010, thus nixing any hopes that Shell had of drilling in its Beaufort and Chukchi leases before the summer of 2011.

Confusion then ensued over whether the Arctic OCS fell within the scope of either Salazar’s initial drilling moratorium or a second, modified moratorium imposed on July 12. However, following statements by Salazar that he had indeed imposed a moratorium on the Arctic and that he could not say when that moratorium would be lifted, the State of Alaska sued the Department of the Interior in Alaska District Court on the grounds that the Arctic moratorium was “arbitrary and capricious” and had been imposed without a legally required public process or consultation with the state.

The state’s suit against Interior has yet to be resolved.

### Further hurdles

And two other as-yet unresolved legal issues still hang over exploration in the Chukchi Sea.

In April 2009 the United States Court of Appeals for the Dis-

trict of Columbia upheld an appeal against the MMS 2007 to 2012 outer continental shelf lease sale program that included the 2008 Chukchi Sea lease sale, thus putting the results of that sale into question. The court instructed MMS to rework its environmental analysis for the Environmental Impact Statement for the lease sale. BOEMRE, the new agency that has replaced MMS, issued a draft revised EIS in April 2010 and since then, in readiness for delivering a completed version of the new EIS to the DC court, BOEMRE has been reviewing the more than 100,000 public comments it received on the draft.

And on July 21, 2010, a judge in the U.S. District Court for Alaska upheld an appeal against the Chukchi Sea lease sale EIS. The judge ordered a stop to all oil and gas lease activity in the Chukchi Sea until BOEMRE corrects what the judge said were some deficiencies in the EIS.

However, the District Court judge did allow Statoil to proceed with a 3-D seismic survey around its leases in the Chukchi Sea in the 2010 open water season and BOEMRE issued a permit for that survey.

In addition, BOEMRE issued a permit to Ion Geophysical to do a basin-wide 2-D seismic survey across the whole of the U.S. Beaufort Sea in the early winter of 2010 — Ion has developed a new technique for gathering offshore seismic from a seismic vessel when sea ice covers much of the sea surface.

Meantime in late August BOEMRE Director Michael Bromwich held a forum in Anchorage, Alaska, as part of a nationwide tour, gathering views on the factors that Interior said underlay its OCS drilling moratorium. Bromwich said that he would report his findings to Interior Secretary Ken Salazar by Oct. 31, and possibly earlier than that.

What position Interior will subsequently take on Arctic OCS drilling remains to be seen.

## Business opportunities and challenges in northern Alaska

The high cost of new oil exploration, development and production in Arctic Alaska has in the past resulted in the North Slope oil industry being the exclusive domain of oil majors, in particular ConocoPhillips (previously ARCO) and BP. However, as the region has matured as an oil province, smaller independent oil companies have made inroads into the region: In 2008, a banner year for independents on the North Slope, Pioneer Natural Resources brought the Oooguruk field in state waters of the Beaufort Sea online, the first production in northern Alaska by an independent oil company.

And although in the early days of the North Slope viable oil development in remote territory at vast distances from oil markets required giant oil fields, the established oil infrastructure is now opening up the possibility of bringing more modest-sized fields online, as the older fields decline. In fact, the Oooguruk field processes its products in facilities at Kuparuk, and potential access to the existing infrastructure has led to active exploration in the Prudhoe Bay area by small companies such as Brooks Range Petroleum and UltraStar.

### Charter for development

A key factor, especially for small companies wanting to explore on the North Slope, is the existence of the Charter for the

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ExxonMobil is a big company with a history in Alaska to match. The company owns the largest share of the Prudhoe Bay unit and helped bring the trans-Alaska oil pipeline into operation in 1977, but also is responsible for the Exxon Valdez oil spill in 1989 that took more than two decades to approach a legal conclusion. Following that spill, Exxon dropped its exploration program and only recently resumed it with efforts to retain the Point Thomson unit on the eastern North Slope. Point Thomson is progressing paradoxically, with Exxon and the state engaged in legal proceedings over the unit while Exxon continues to drill. Exxon finished drilling the PTU-15 injector well at Point Thomson in February 2010 and finished the PTU-16 producer well in July. Those wells are the first drilling activity at the unit since 1983. Through the \$1.3 billion gas cycling project, Exxon hopes to start producing hydrocarbon liquids from the unit by 2014.



DALE PITTMAN

NAME OF COMPANY: ExxonMobil  
 HEADQUARTERS OF PARENT COMPANY: Houston, Texas  
 HEADQUARTERS IN ALASKA: 3301 C St Ste 400, Anchorage, AK 99503  
 TOP EXECUTIVE IN ALASKA: Dale Pittman, Alaska production manager  
 MAIN ALASKA TELEPHONE: 907-561-5331 • FAX: 907-564-3789  
 COMPANY WEBSITE: www.exxonmobil.com



Exxon is also involved in another long-sought-after Alaska project: a natural gas pipeline from the North Slope to southern markets. A state-backed effort by TransCanada and ExxonMobil held the first open season for a North Slope gas pipeline in Alaska history this past summer

and "received multiple bids from major industry players and others for significant volumes," the companies said. Natural gas plays a major role in Exxon's vision for the future, as seen by its \$31 billion acquisition of XTO Energy. If finalized, that sale could make ExxonMobil an Alaska operator; XTO owns two oil and gas platforms in Cook Inlet. Exxon leases some 135,000 acres of state land in Alaska.

**Current exploration focus:**

**Northern Alaska:** Exxon recently completed its first injector and producer wells at the Point Thomson unit in the eastern North Slope, as part of a gas cycling program.

Development of the Alaskan North Slope, the charter that resulted from the settlement between the State of Alaska, BP and ARCO when BP purchased ARCO in 1999. Under the charter both BP and ConocoPhillips, the two major North Slope operators, have to be willing to negotiate the shared use of their facilities with new producers, and must buy third-party oil for shipment down the trans-Alaska oil pipeline. The charter also makes certain seismic data available to small companies, a major factor in reducing exploration costs.

However, companies wanting to negotiate facility access need to recognize that facility sharing will incur costs, including the potential cost of the impact of third-party processing on production from the facility operator's own fields.

And the cost of shipping oil to market, including the tariff for shipping the oil on the trans-Alaska oil pipeline and the cost of carrying the oil by tanker from Valdez at the southern end of the pipeline, is a major factor in the economics of North Slope oil. The pipeline tariff, a topic of much controversy and dispute among oil shippers, pipeline owners, government regulators and

the State of Alaska, tends to rise as North Slope production declines, as the pipeline fixed costs become spread across progressively fewer barrels of oil.

On the other hand, the trans-Alaska oil pipeline owners and Alyeska Pipeline Service Co. have done major upgrades to the pipeline system and the Valdez Marine Terminal, to improve the pipeline system efficiency and to enable the pipeline to more cost effectively adjust to variations in throughput.

**Very expensive**

Oil exploration and development in northern Alaska is also much more expensive than in, say, the Lower 48, in part because of the logistical difficulties of working in a harsh climate in an extremely remote region, and in part because of the seasonal nature of most work.

The seasonal nature of the work results from the fact that, onshore, almost all off-road or off-gravel pad drilling or construction needs to be done during the winter, when the tundra is frozen and protected by a layer of snow. In fact, both the State of Alaska and the U.S. Bureau of Land Management have rules and procedures for determining when they will allow off-road travel on state or federal land, ensuring that the tundra will not be damaged but also limiting any work off the established road system to just a few months of the year.

And access to a remote site typically requires construction of an ice road, with the road construction adding to project costs and eating into the time available for work at the site.

During a remote exploration drilling project, for example, it may only be possible to drill a single well in one winter exploration season; it then becomes necessary to wait until the following winter to drill another well. If a new field is found, appraisal drilling may extend over several winter seasons, significantly delaying the start of field production.

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Renaissance may be small, but it's still aiming big. The Houston independent sold most of its Alaska acreage this year, but kept the Umiat prospect, one of the largest undeveloped oil fields on the North Slope. Renaissance arrived in Alaska in 2006, building up land positions both on the North Slope and in the Cook Inlet basin. In Cook Inlet, Renaissance picked up the offshore Northern Lights oil prospect, previously known as Sunfish, as well as the offshore Middle Ground Shoal and Northwest Cook Inlet prospects, and the North Sterling and West Eagle prospects on the Kenai Peninsula. On the North Slope, Renaissance pursued Umiat, near the Colville River on the east side of the National Petroleum Reserve-Alaska. Umiat is one of many northern prospects discovered by the U.S. Navy and the U.S. Geological Survey in the 1940s and 1950s.



ALLEN HUCKABAY

In early 2009, Renaissance transferred Northern Lights to Escopeta Oil as part of a three-company lease swap that led to the creation of the Kitchen Lights unit. In late 2009, Renaissance transferred its remaining Cook Inlet acreage to Stellar Oil and Gas, a sister company made up of the same investors and executives, a way to focus fundraising efforts for its Cook Inlet acreage. In March 2010, Stellar turned around and sold

NAME OF COMPANY: Renaissance Alaska, LLC  
 HEADQUARTERS OF PARENT COMPANY: 7250 Tanglewilde Ave., Suite 340, Houston, TX 77063  
 HEADQUARTERS IN ALASKA: 611 "O" St., Unit 4, Anchorage, Alaska 99501  
 HEADQUARTERS TELEPHONE: 281-768-7650  
 TOP EXECUTIVES: William Allen Huckabay, Mark R. Landt and James S. Watt  
 MAIN ALASKA TELEPHONE: (907) 771-0700  
 EMAIL: mlandt@renaissancealaska.com, jwatt@renaissancealaska.com, ahuckabay@renaissancealaska.com  
 COMPANY WEBSITE: www.RenaissanceAlaska.com



MARK LANDT



JAMES S. WATT

the acreage to Australian independent Buccaneer Resources. Now, the Renaissance-Stellar team works for Buccaneer Alaska, which is aggressively pursuing multiple prospects. Throughout that shuffle, though, Renaissance kept 19,348 acres of state and federal leases at Umiat. The Renaissance team still wants to develop the field. In partnership with other independents, Renaissance planned to drill at Umiat in early 2008, but the risky program, combined with a shortened drilling season that year, prompted the company to shoot 3-D seismic instead. The results from that shoot suggested 250 million barrels of recoverable oil at Umiat, encouraging enough to keep the leases. Renaissance is now pinning its hopes on state plans to build a road and pipeline corridor to Umiat, a major infrastructure project that would significantly lower development costs in the Brooks Range foothills.

**Current exploration focus:**

**Northern Alaska:** Renaissance wants to develop the Umiat oil field in the foothills of the Brooks Range and is tying its efforts to state plans to build a road to the Umiat area.

This seasonality of exploration and development characterizes the steady march west toward and into northeastern NPR-A by ConocoPhillips and Anadarko, with the drilling of one or two new wells each winter. And in the foothills around Umiat Anadarko and its partners have been doggedly proceeding, a well or two at a time, in their investigation of the gas potential of what they term the "Gubik Complex."

Environmental permitting is also a critical issue for oil companies operating on the North Slope — no one can allow environmental mismanagement or an environmental disaster to damage the fragile Arctic environment. A serious environmental incident could cause irreparable damage to the oil industry's "license to operate" in the far north.

However, despite a view among some that strict environmental controls in Alaska place difficult obstacles in the way of would-be oil and gas explorers, and criticism of what some perceive as undue complexity in the permitting process, independent companies such as Anadarko, Pioneer, Brooks Range Petroleum and UltraStar have demonstrated that, with appropriate expertise, the maze of environmental regulations can be successfully mastered.

**OCS challenges**

With a whole set of special challenges, including the immensely high cost of operating in ice-infested seas in a region of

great environmental sensitivity, exploration on the outer continental shelf of the Beaufort and Chukchi seas is the domain of major oil companies. Offshore drilling typically involves the use of an ice-reinforced drilling vessel guarded from sea ice by ice breakers. And exploration drilling has to be carried out during the relatively short open water season, lasting perhaps from early July into late October.

Shell, hoping to start an aggressive Beaufort Sea drilling program in 2007, ran into a barrage of opposition from environmental groups concerned about the possible impact of industrial activities on the delicate offshore environment and from North Slope communities concerned both about environmental impacts and about possible disruption of their traditional subsistence hunting, especially the hunting of bowhead whales.

And, despite scaling back its drilling plans to address concerns about the scale of its proposed activities, the company has yet to sink a drill bit into the seafloors of either the Beaufort or Chukchi seas since embarking on its current OCS exploration program.

**GOM repercussions**

The April 2010 blowout of BP's Macondo well in the Gulf of Mexico added fuel to an already contentious debate over the

Although Shell and ConocoPhillips are the center of attention for Chukchi Sea exploration, they aren't the only companies looking to drill in the outer continental shelf off the northwestern coast of Alaska. The Norwegian company Statoil recently completed a 3-D seismic survey over leases it holds jointly with Eni Petroleum. Statoil, then StatoilHydro, bid \$14 million on 16 tracts in the Chukchi Sea during a record breaking federal lease sale in February 2008. Through a cash and trade deal, Statoil picked up a 25 percent stake in 50 ConocoPhillips leases in the Chukchi Sea in January 2010.

Statoil announced its program in April. It plans to shoot 3-D seismic over 915 square miles, mostly located more than 100 miles offshore. That program almost didn't happen this year. A court injunction over Chukchi Sea drilling appeared to also cover seismic work, and a federal moratorium over offshore drilling in the wake of the Gulf of Mexico oil spill created uncertainty about all offshore activities. Statoil ultimately got its final permits just in

NAME OF COMPANY: Statoil  
 HEADQUARTERS OF PARENT COMPANY: Stavanger, Norway  
 MAIN COMPANY TELEPHONE: 475-199-0000  
 MAIN COMPANY FAX: 475-199-0050  
 COMPANY WEBSITE: www.statoil.com



time, though. Time and money permitting, Statoil said it might also shoot 2-D seismic over a broader area of the Chukchi Sea to learn more about older well sites.

**Current exploration focus:**

**Northern Alaska:** Statoil is shooting 3-D seismic over offshore acres it holds in a 60-40 partnership with Eni Petroleum. The company might also shoot 2-D seismic this year.

possibility of an oil spill in the Arctic offshore, and over the practicalities of responding effectively should a spill occur. Critics of OCS oil development say that the risk of an offshore oil spill cannot be eliminated, that oil recovery techniques for use in ice-laden waters are as yet unproven and that there is an insufficient support infrastructure in the Arctic to mount a major oil spill response effort.

And following the Gulf of Mexico disaster the U.S. Department of the Interior has imposed a ban on Arctic OCS oil drilling, pending completion of a review of offshore drilling safety.

Shell has said that the shallow waters of the Arctic OCS do not present the same level of risk as the deepwater of the Gulf of Mexico where the Macondo well was being drilled, and that the company's careful well planning combined with remote monitoring of drilling operations and the use of multiple levels of well control all but eliminate the possibility of a blowout during the drilling of an Arctic OCS well.

As contingency against the possibility of what it views as a highly unlikely oil spill event, the company has assembled a formidable spill response fleet that includes a new purpose-built ice-class oil spill response vessel, an oil spill response barge and a 500,000-barrel-capacity oil tanker. That fleet would be stationed offshore while drilling is in progress, ready to swing into action within an hour should an oil spill occur, Shell says.

And following lessons learned in the Gulf of Mexico, the company is commissioning the construction of a well-head containment dome for use in the Arctic. Shell is also activating its Kulluk floating drilling platform as a backup platform for the drilling of a relief well, should a blowout occur.

Shell has pointed to a joint industry research program coordinated by Norwegian research company SINTEF that in early 2010 published the results of several years of research into oil spill response techniques for use in sea ice conditions. That research demonstrated the successful recovery of oil from water between ice floes using appropriately designed oil skimmers, in-situ burning and other techniques.

Most North Slope communities support onshore oil and gas development but those same communities have many reservations about offshore development, often characterizing the Arctic seas as their "garden," an essential resource for their

traditional culture. In addition to concerns about the potential for an offshore oil spill, these communities worry about the possible impact of industrial noise on the marine mammals that form the core their subsistence food supplies.

In response, Shell says that it respects the needs of the North Slope communities and is taking care to accommodate those needs. The company says that offshore oil and gas development will provide jobs and careers for Alaskans, and that new oil from offshore will extend the life and improve the economics of the

*continued on next page*

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Suncor Energy arrived in Alaska by acquiring Petro-Canada in mid-2009 and the degree to which the Canadian company plans to stay in Alaska remains unknown. By inheriting Petro-Canada's landholdings in Alaska, Suncor picked up some 1 million net acres in the foothills of the Brooks Range (working with operator Anadarko and partner BG Alaska), and in the National Petroleum Reserve-Alaska (in partnership with operator FEX). In September 2009, Suncor announced plans to focus on oil sands and divest much of its natural gas holdings by the end of 2010. Because neither Anadarko nor FEX drilled exploration wells in 2010, Suncor wasn't forced to make a major spending decision in Alaska. That lack of drilling could carry over to 2011, which would give Suncor more time to make a decision. Suncor may not need the time, though. The company recently wrote down \$44 million in Alaska and Western Canadian assets and put its NPR-A oil prospects up for sale. The company continues to evaluate its



RICK GEORGE

NAME OF COMPANY:  
Suncor Energy Inc.  
HEADQUARTERS OF PARENT COMPANY: Calgary, Alberta Canada  
CHIEF EXECUTIVE OFFICER:  
Rick L. George, president and CEO  
MAIN TELEPHONE: 403-296-8000  
MAIN FAX: 403-296-3030  
COMPANY WEBSITE: www.suncor.com



foothills gas prospect.

#### Current exploration focus:

**Northern Alaska:** Suncor acquired leases in the foothills of the Brooks Range and in the National Petroleum Reserve-Alaska, but hasn't completely stated its intentions for Alaska, placing its NPR-A acreage up for sale, but continuing to evaluate foothills gas.

trans-Alaska oil pipeline, as well as provide new sources of much needed oil for the United States.

#### North Slope gas pipeline

The future possibility of a gas pipeline that would deliver North Slope gas to market has some bearing on the focus of petroleum exploration and development in northern Alaska. And, in 2010, the gas line open seasons conducted by TransCanada and ExxonMobil's Alaska Pipeline Project, and by Denali, the joint venture of BP and ConocoPhillips, presumably place gas line construction go-no-go decisions on the not too distant horizon.

On the North Slope, BP has been planning how best to transition into gas production at the giant Prudhoe Bay field, the biggest initial source of gas for a pipeline. To date, gas produced from the field has been mostly re-injected into the field reservoir to maintain reservoir pressure and to coax as much oil as possible from the reservoir rock. BP, working in conjunction with the Alaska Oil and Gas Conservation Commission, must find a way to produce gas without unduly compromising the ultimate volume of oil recovered from the field.

To the east of Prudhoe Bay, ExxonMobil is at last developing the Point Thomson field, the other field considered to be a primary source of gas for a gas pipeline. Point Thomson is a gas condensate field and ExxonMobil has embarked on a project to prototype the production of condensate from the field using a gas cycling procedure. Condensate has a higher economic value than natural gas, a situation that, despite the huge volumes of gas at Point Thomson, drives a need to give condensate production priority over gas production, at least until as much condensate as possible has been produced.

And the improving odds of a North Slope gas pipeline coming into existence have driven a flurry of exploration activity in the gas-prone region of the North Slope foothills, with Anadarko and its partners drilling wells in known gas fields such as Gubik in the region around Umiat on the Colville River. An interest by several companies in oil and gas leasing in the foothills region in recent years presumably also reflects a view that the long-anticipated gas pipeline concept has at least reached the open season stage.

## Petroleum geology of northern Alaska

The geological history of northern Alaska has resulted in four distinct rock sequences. From oldest to youngest, these sequences are known as the Franklinian, Ellesmerian, Beaufortian and Brookian. People also refer to the Franklinian as the pre-Mississippian sequence and the Beaufortian as the rift sequence.

The oldest rock sequence, the Franklinian, formed on a stable continental platform before middle Devonian time (about 400 million years ago). The sequence contains a wide range of rock types, some of which may have been laid down as sediments on subsea slope deepening to the south.

The Franklinian sequence is often considered nonprospective "basement" due to its high thermal maturity and generally poor reservoir quality. However, shows of migrated oil are common in basement penetrations along the Barrow Arch; wells in the Point Thomson area have penetrated zones of dolomites with reservoir potential; and the Point Thomson gas condensate reservoir includes Franklinian carbonates. Economic production from pools in the Franklinian remains a possibility at some point in the future.

Franklinian sequence deposition ended across most of northern Alaska with a cycle of middle to late Devonian mountain building and metamorphism.

#### The Ellesmerian

Ellesmerian sediments, eroded from uplifted Franklinian rocks in a landmass that lay mostly to the north of the modern Beaufort Sea coast, spread southward and accumulated in the coastal and marine settings of an ancient basin known as the Arctic Alaska basin. Deposition of these sediments on a continental margin, sloping to the south, persisted into early or middle Jurassic time.

Deposited in highly varied marine-to-nonmarine settings over at least 150 million years, Ellesmerian strata constitute a diverse suite of rock formations, including prolific petroleum source rocks, excellent reservoirs and strong seal units that

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JUDY PATRICK

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NAME OF COMPANY:  
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COMPANY HEADQUARTERS:  
Anchorage, Alaska  
TOP EXECUTIVE IN ALASKA: Jim Weeks  
MAIN ALASKA TELEPHONE: 907-258-2969  
ALASKA FAX: 907-258-5092  
EMAIL FOR INFO: jweeks@ultrastarexploration.com



Oliktok Point State No. 1 in 2003, looking for oil. He formed UltraStar in 2002 to chase prospects west of Point McIntyre uncovered by a package of 3-D seismic he acquired. After several years of hurdles, UltraStar drilled Dewline No. 1 in early 2009 to target oil prospects. Weeks called it a “good well,” but offered no further details and abandoned the well. In June 2009, UltraStar got ap-

proval to form the Dewline unit over three leases tucked between the Prudhoe Bay and Northstar units. Now, UltraStar is planning to drill a follow-up well at Dewline in early 2012. Under the terms of the unit, UltraStar is required to drill a second well at Dewline by May 2013. Weeks' companies hold some 7,000 acres.

#### Current exploration focus:

Northern Alaska: UltraStar drilled a well at Dewline Deep, a modest oil pool close to current infrastructure, in 2009 and plans to drill a directional follow-up in early 2012.

collectively define a self-contained, world-class petroleum system.

The strata of the Ellesmerian sequence tend to thin to the south, under the North Slope, because of the increasing distance from the source of the sediments in the north. They also tend to thin to the north of the North Slope, in the area of the ancient Ellesmerian landmass, in part because deposition was truncated against the landmass and in part because later uplift caused erosion of any sediments that had earlier been deposited.

#### The Beaufortian sequence

The Beaufortian sequence dates from between early to middle Jurassic and early Cretaceous and resulted from sediment deposition during major rifting or pulling apart of the earth's crust. People have proposed several hypotheses for this rifting. However, most geologists interpret the rifting as a result of the opening up of the Canada basin of the Arctic Ocean by a counterclockwise rotational movement of the North Slope Ellesmerian landmass away from equivalent platform rocks in Arctic Canada.

The east-west trending structural high known as the Barrow arch developed along the present Beaufort Sea coast. According to the most widely accepted Beaufortian rift model the arch formed in multiple uplift phases. The northern flank of the arch slopes steeply in a system of faults toward the Canada basin of the Arctic Ocean. The southern flank slopes very gently.

Widespread surface erosion along the Barrow arch probably occurred several times but culminated during the early Cretaceous to form an unconformity of regional east-west extent. This lower Cretaceous unconformity forms an important hydrocarbon migration and accumulation element for many of the oil fields on the North Slope, including the Prudhoe Bay field.

Most of the Beaufortian sediments eroding from the rising Barrow arch likely drained off the gentle southern flank of the arch, where they later became buried deep beneath younger sediments of the Brookian sequence. Other erosion products from the Barrow arch no doubt drained into the depths of

fault-dropped blocks on the north side of the arch. Beaufortian sediments also accumulated in a variety of mostly shallow marine settings on the uplifted margin of the Barrow arch. These sediments formed important sandstone reservoirs in subtle low points on the arch or perched on rift-related fault blocks stepping off the arch to the north. Key examples include the Lower Cretaceous Kuparuk formation sandstones of the Kuparuk River and Point McIntyre fields and the Upper Jurassic Kingak formation sandstones of the Alpine field.

#### The Brookian

Also in late Jurassic and early Cretaceous time the Brooks Range started to form, sending thick sheets of thrust-faulted rock to the north. These thrust sheets loaded and depressed the earth's crust and caused a deep depression called the Colville basin to start to sink along the northern side of the range, between the range and the Barrow arch.

Sediments eroded from the Brooks Range thrust sheets poured into the Colville basin, progressively filling the basin from southwest to northeast and forming the Brookian sequence. Brookian sediments also spread out over the Barrow arch and onto Alaska's continental margin during Cretaceous-through-Tertiary time.

In very general terms, the older, lower Brookian sequence sediments tend to consist of shales and sandstones deposited in water hundreds or thousands of feet deep. The rocks higher in the sequence typically consist of sandstones and shales associated with coastal plains, river deltas or other shallow-water environments.

While sediments filled the Colville basin, the area of active sedimentation moved eastward. As a result, the Brookian rocks tend to become younger from west to east in the basin.

Nowadays Quaternary sediments cover the older bedrock along the North Slope. Most Quaternary deposits consist of unconsolidated sand and gravel, containing re-worked Brookian sediments along with materials from the present-day Brooks Range. Overlying these deposits are river-deposited silts and sandy silts that include variable amounts of organic matter. In addition to river deposits, windblown sands within the Quaternary sequence mark cold, dry Ice Age conditions.



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