The History and Areal Distribution of Exploration Drilling Targets
Categorized by Play Type, North Slope and Offshore Arctic Alaska*

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Abstract

News headlines touting large oil discoveries, such as the recently announced 0.5-1 billion-barrel oil accumulations in the Nanushuk topset play, have a history of influencing exploration drilling in North Alaska. Interested explorers ask, what wells targeted this play? Where are the producing analogues? Who successfully or unsuccessfully targeted this play in the past? This comprehensive study documents the drilling target by play type from public domain information for 548 exploration wells on the North Slope of Alaska, Beaufort Sea and Chukchi Sea. The discovery well and production data for each producing pool are integrated into the study to address the explorers’ questions.

To date, 17.9 billion barrels of liquid hydrocarbons have been produced from North Alaska. Wells have targeted five main play types: Ellesmerian clastics and carbonates (Kekiktuk, Lisburne, Ivishak, Shublik, and Sag River), Jurassic shoreface sands (Barrow, Simpson, Kugrua, Nechelik, Nuiqsut, and Alpine), Cretaceous rift sands (Walakpa, Kuparuk, Put River, Kemik, and Thomson), Brookian turbidites (Torok, Seabee, and Canning), and Brookian topsets (Nanushuk, Tuluvak, Schrader Bluff, West Sak, Ugnu, Prince Creek, and Sagavanirktok). A sixth category called ‘Other’ includes the remaining targets (e.g., basement and methane hydrates). A series of maps and diagrammatic cross sections show the spatial distribution of wells targeting each play type. Drilling target timelines illustrate the progression from exploration to discovery to delineation and then production. In each play type, key discoveries ignite a flurry of drilling activity. Exploration activity targeting the Ellesmerian was greatest after the discovery of Prudhoe Bay in 1968 and continued at an elevated rate through 1986. Exploration of the Jurassic shoreface sands saw two pulses in the early and mid-1980s that led to the oil discovery in the Nuiqsut sands at Oooguruk. Jurassic exploration continued from 1992 to 2015, spurred by the giant Alpine field discovery in 1994. Cretaceous rift sands have regularly been a drilling target since the Kuparuk River field was discovered 1969. Brookian topset and turbidites were the earliest targets starting in the 1940s with spikes in exploration activity in every decade since 1964. Exploration wells delineating recently announced Nanushuk topset discoveries outnumbered every other play in 2018.
References Cited


Gregersen, Laura S., Brown, Garrett A., 2019, Map and Database of Exploration Drilling Targets Categorized by Play Type, North Slope and Offshore Arctic Alaska: Alaska Department of Natural Resources, Division of Oil and Gas. Available online at: http://dog.dnr.alaska.gov/Information/Studies


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AAPG 2019 Annual Convention & Exhibition

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**North Alaska Exploration Wells**

- Identified by Sale Regions

![Graph showing the number of exploration wells drilled by completion date and source.](image)

**Completion Date (Year)**

**Number of Exploration Wells Drilled**

- US Navy
- US Navy & USGS
- USGS

Data source: AOGCC; AKDOG Public Decisions; BLM
North Alaska Exploration as Influenced By
- Land Availability, Pipeline Access, and Key Discoveries -

Number of Exploration Wells Drilled

Completion Date (Year)

Oil + NGL Production (M BBL/Day)

Data sources: AOGCC; AKDOG; BLM; PNA
WHAT PLAYS ARE THE EXPLORERS TARGETING?
- Generalized Stratigraphic Column and Cross Section -

Figure modified from Houseknecht and Bird, 2006; Garrity and others, 2005; and AKDOG.
How do Plays Contribute to Production? - Throughout Time and Today -

North Alaska Oil + NGL Production by Play Type

- Percent of Cumulative Production through 2018 (~18 Billion BBLS)
- Percent of Production in 2018 (187 Million BBLS)

Data source: AOGCC; AKDOG

Figure modified from Houseknecht and Bird, 2006; Garrity and others, 2005; and AKDOG.
EXPLORATION DRILLING TARGETS – ALL CATEGORIES
- AND REGIONAL TECTONIC ELEMENTS -

Anticlinal Trends
Kirshner, 1994

Beaufort Sea
Chukchi Sea
Arctic Ocean

Barrow Arch

NPRA
ANWR 1002 Area
Sadlerochit Mtns
BROOKS RANGE
EXPLORATION TARGETS AND DISCOVERIES
- ELLESMERIAN CLASTICS AND CARBONATES -

Data sources: AOGCC; AKDOG; USGS; BOEM; DOE/NETL

Completion Date (Year)

Oil + NGL Production (M BBLs/Day)

Number of Wells Targeting Objective

- US Navy
- US Navy & USGS

Kemik, 1972
Sandpiper, 1986
PBU NPB, 1970
N Star Ivsk, 1984
EDCT Ivsk, 1982
Kavik, 1969
EDCT Kkkk, 1978
Gwyder Bay, 1969
MPU Sgrv, 1969
PBU Ivsk & PBU Lsbr, 1968
PBU Raven, 2001
EDCT Eider, 1998
Liberty, 1997
PBU Ptmc Ivsk, 1997
EDCT Sgrv Ivsk, 2009

- Discovery (Undeveloped)
- Discovery (Developed)
- Discovery (Produced > 440 MM BBLs)
ELLESMERIAN EXPLORATION TARGETS
- CLASTIC AND CARBONATE DEPOSITION ON A STABLE SHELF -

Map showing the locations of Ellesmerian exploration targets in the Beaufort Sea and Chukchi Sea. The map highlights the Barrow Arch and the Beaufort Sea, with the Arctic Ocean in the background. The inset diagram shows stratigraphic columns for Triassic, Permian, Pennsylvanian, and Mississippian eras, with specific formations like Shublik Fm. and Lisburne Group.
ELLESMERIAN EXPLORATION TARGETS
- Kekiktuk Formation: Non-marine -

Arctic Ocean

Chukchi Sea

Beaufort Sea

Northern Pacific Rim Arch (NPRA)

NPRA 1002 Area

ANWR 1002 Area

Sadlerochit Group

Lisburne Group

Shublik Fm.

Sadlerochit Group

Lisburne Group

Sadlerochit Group

Kekiktuk Fm.

Triassic

Permian

Pennsylvanian

Mississippian

BROOKS RANGE

100 Miles

50 Miles

Beaufort Sea

Arctic Ocean

Chukchi Sea

NPRA 1002 Area

ANWR 1002 Area

Sadlerochit Group

Lisburne Group

Shublik Fm.

Sadlerochit Group

Lisburne Group

Sadlerochit Group

Kekiktuk Fm.

Triassic

Permian

Pennsylvanian

Mississippian
Ellesmerian Exploration Targets - Lisburne Group: Platform Carbonates -
ELLESMERIAN EXPLORATION TARGETS
- SHUBLIK AND SAG RIVER FORMATIONS: MARINE -

100 Miles
Beaufort Sea
Chukchi Sea
Arctic Ocean

Barrow Arch

Sag River Fm
Shublik Fm
Sadlerochit Gp
Lisburne Gp
Kekiktuk Fm

NPRA
ANWR 1002 Area

BROOKS RANGE
EXPLORATION TARGETS AND DISCOVERIES
- JURASSIC SHOREFACE -

Number of Wells Targeting Objective

Completion Date (Year)

Oil + NGL Production (M BBLS/Day)

Data sources: AOGCC; AKDOG; USGS; BOEM; DOE/NETL
JURASSIC SHOREFACE EXPLORATION TARGETS
- EARLY RIFTING: OPENING OF ARCTIC OCEAN -
Cretaceous Rift Exploration Targets - Continued Rifting and Uplift of Barrow Arch -

- Beaufort Sea
- Chukchi Sea
- Arctic Ocean
- NPRA
- ANWR 1002 Area
- Foothills
- KUPARUK
- BURGER WALAKPA
- KEMIK
- THOMSON
- PUT RIVER
- LCU Subcrop Map (Bird, 1998)

LCU to Inishak Fm Isochore (public well picks)

LCU to Inishak Fm Isochore (public well picks)
EXPLORATION TARGETS AND DISCOVERIES BY YEAR
- BROOKIAN TURBIDITE -

Number of Wells Targeting Objective vs. Completion Date (Year)

Data sources: AOGCC; AKDOG; USGS; BOEM; DOE/NETL
brookian turbidite exploration targets
- filling in colville trough: pro-delta to deep marine -
**Brookian Topset Exploration Targets**
- Coeval Non-marine, Shallow Marine, and Delta -

- Beaufort Sea
- Chukchi Sea
- Arctic Ocean
- Beaufort Sea
- NaNushuk Fm
- Tuluvak Fm
- Sagavanirktok Fm
- PCCK/SCBF/WSSK
- NPRA
- ANWR 1002 Area
- Foothills
- Willow
- Grandstand
- Brooks Range
EXPLORERS AND DISCOVERERS
- ALASKA THANKS YOU -

**Explorer**

- ARCO ConocoPhillips
- BP Amoco SOHIO
- Navy USGS Husky Oil DOI
- Chevron Texaco Union Unocal SoCal Tenn Gulf
- Exxon Mobil Humble Sinclair
- SHELL
- Oil Search REPSOL Armstrong
- ANADARKO Kerr McGee
- Hamilton Bro McCulloch Co O&G MalVaugh
- One Well Operators Encana Total
- PIONEER Caelus
- BROOKS RANGE
- TECK COMINCO
- N.S. BOROUGH
- FEX
- ENI
- AMERADA HESS
- SAVANT
- GREAT BEAR
- ASRC
- ACCUMULATE ENERGY

**Number of Exploration Wells Drilled**
CONCLUSIONS

1. Land availability, pipeline access, and large oil discoveries have historically fueled exploration drilling in North Alaska.
2. Mapping exploration drilling targets by stratigraphic play type highlights regional geologic trends.
3. Ellesmerian reservoirs have contributed more oil than any other play type, with Cretaceous rift reservoirs coming in second.
4. Exploration discoveries in the past two decades have resulted in the Jurassic shoreface reservoirs and Brookian topset reservoirs making up a larger portion of our present day production (22% in 2018).
5. Giant sized oil accumulations are still being discovered in North Alaska.
6. The Map and Database of Exploration Drilling Targets Categorized by Play Type, North Slope and Offshore Arctic Alaska (Gregersen and Brown, 2019) is available on the Alaska Division of Oil and Gas’ website: http://dog.dnr.alaska.gov/Information/Studies
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REFERENCES CITED


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