

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, Tuvuvak, 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.

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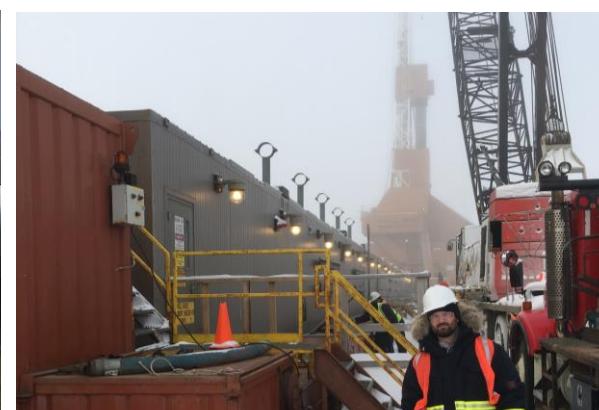
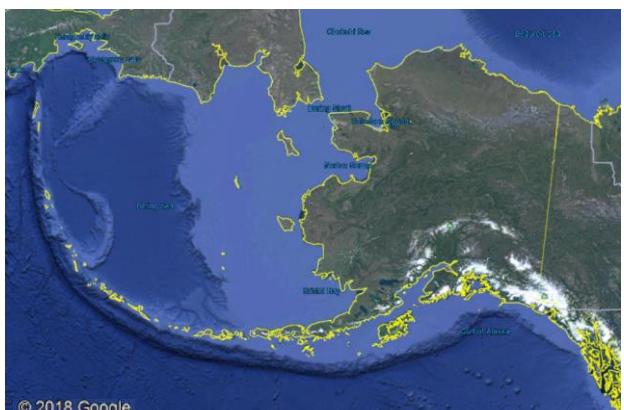
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Presentation by Laura Gregersen, Petroleum Geologist

Co-author: Garrett Brown, Geologist

Alaska Department of Natural Resources, Division of Oil and Gas

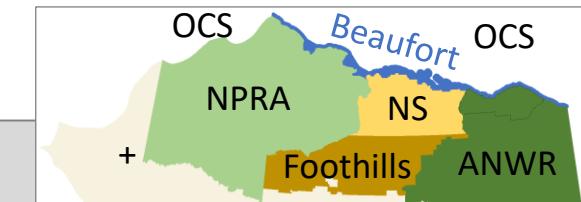
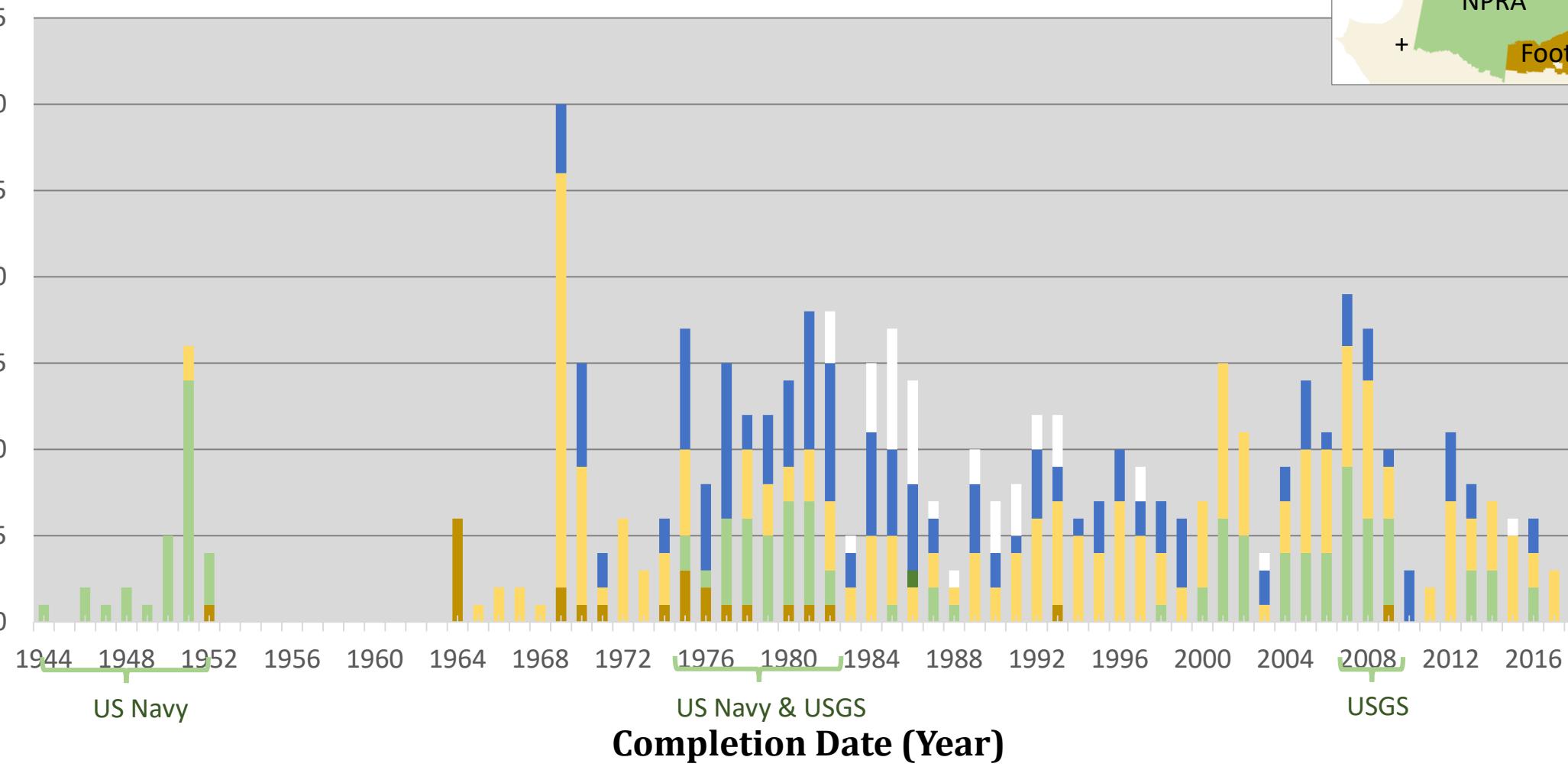
May 22, 2019



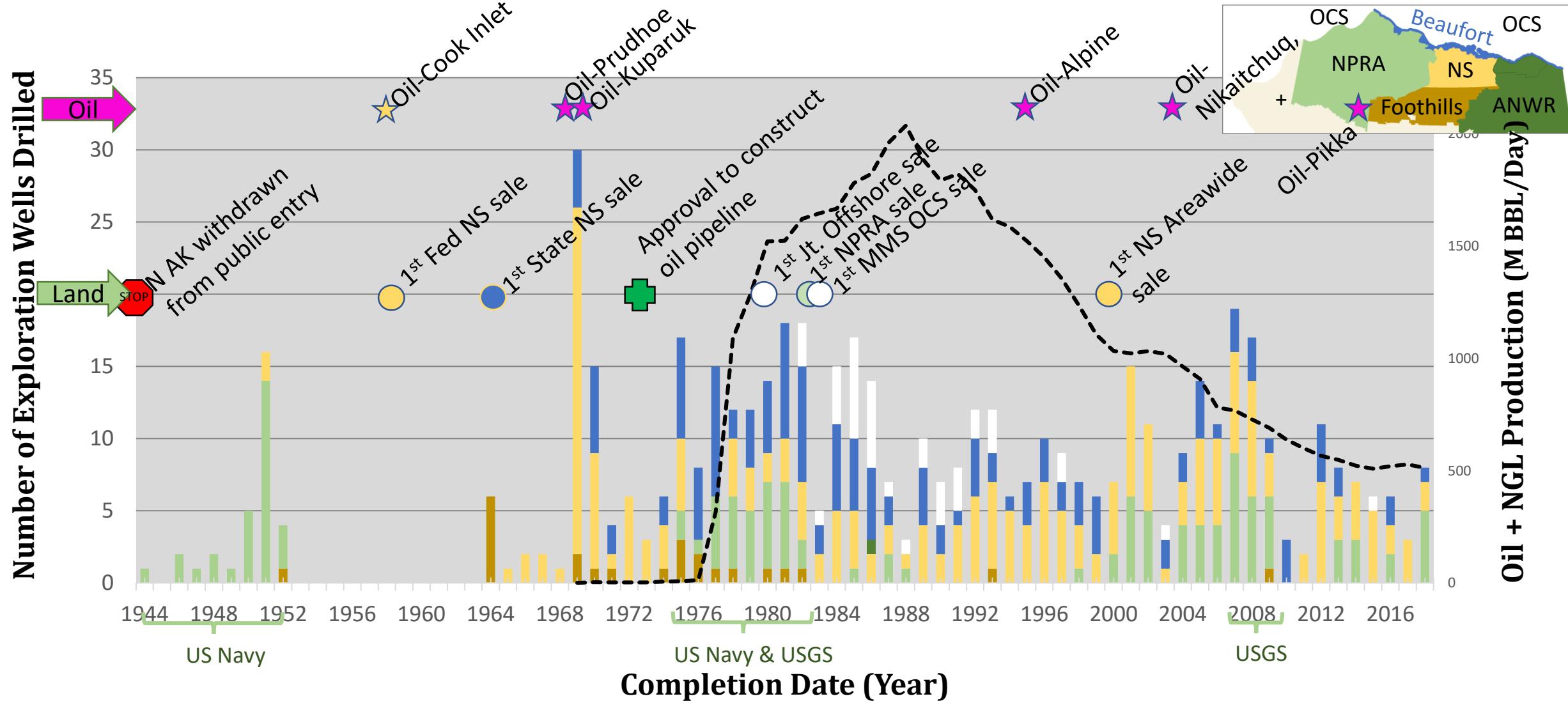
NORTH ALASKA EXPLORATION WELLS

- IDENTIFIED BY SALE REGIONS -

Number of Exploration Wells Drilled



NORTH ALASKA EXPLORATION AS INFLUENCED BY - LAND AVAILABILITY, PIPELINE ACCESS, AND KEY DISCOVERIES -



WHAT PLAYS ARE THE EXPLORERS TARGETING?

- GENERALIZED STRATIGRAPHIC COLUMN AND CROSS SECTION -

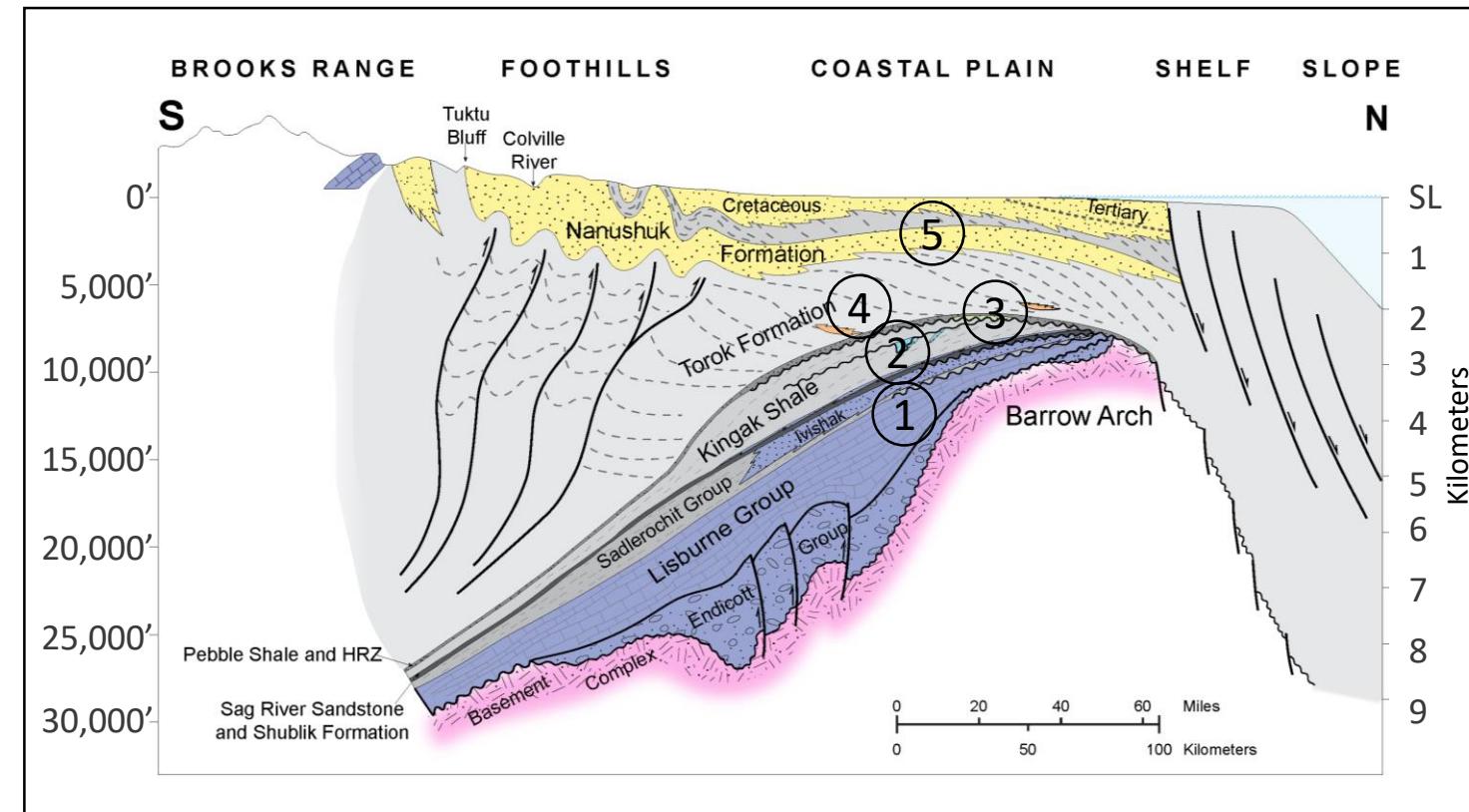
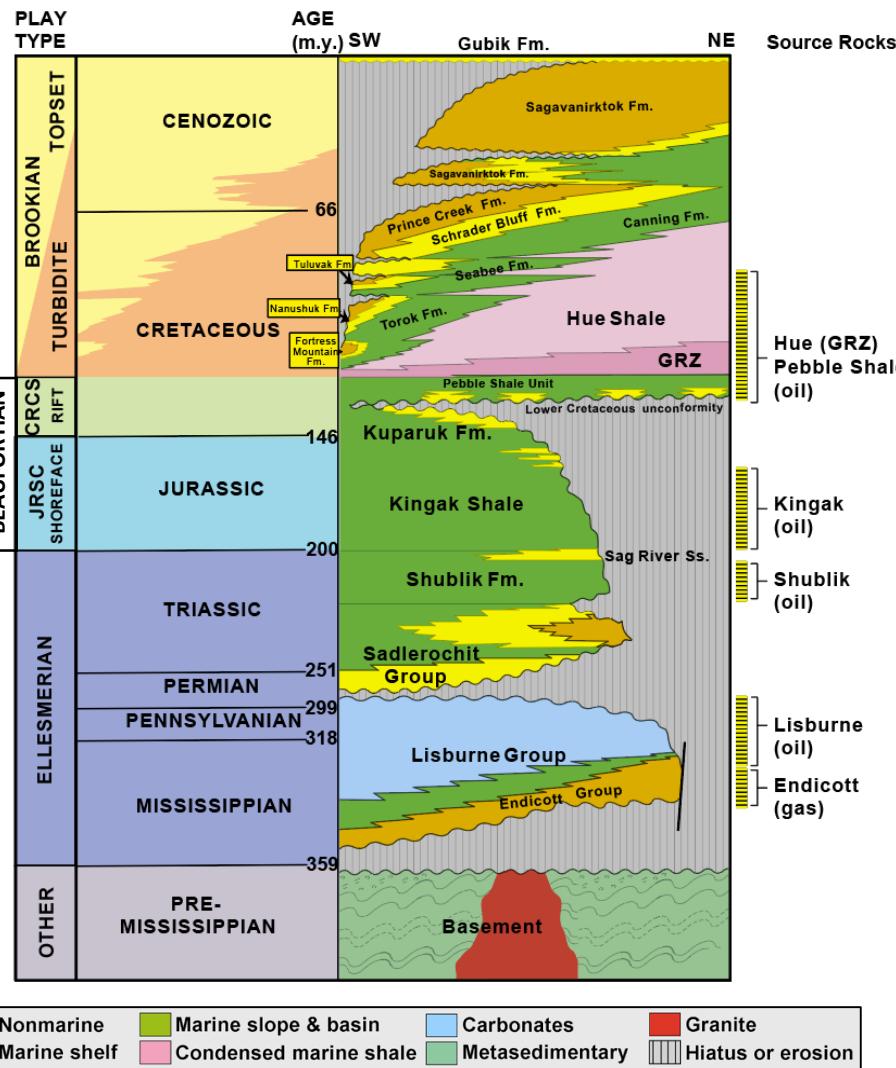


Figure modified from Bird and Molenaar, 1992; AKDOG; DGGS; and P. Decker personal communication.

HOW DO PLAYS CONTRIBUTE TO PRODUCTION?

- THROUGHOUT TIME AND TODAY -

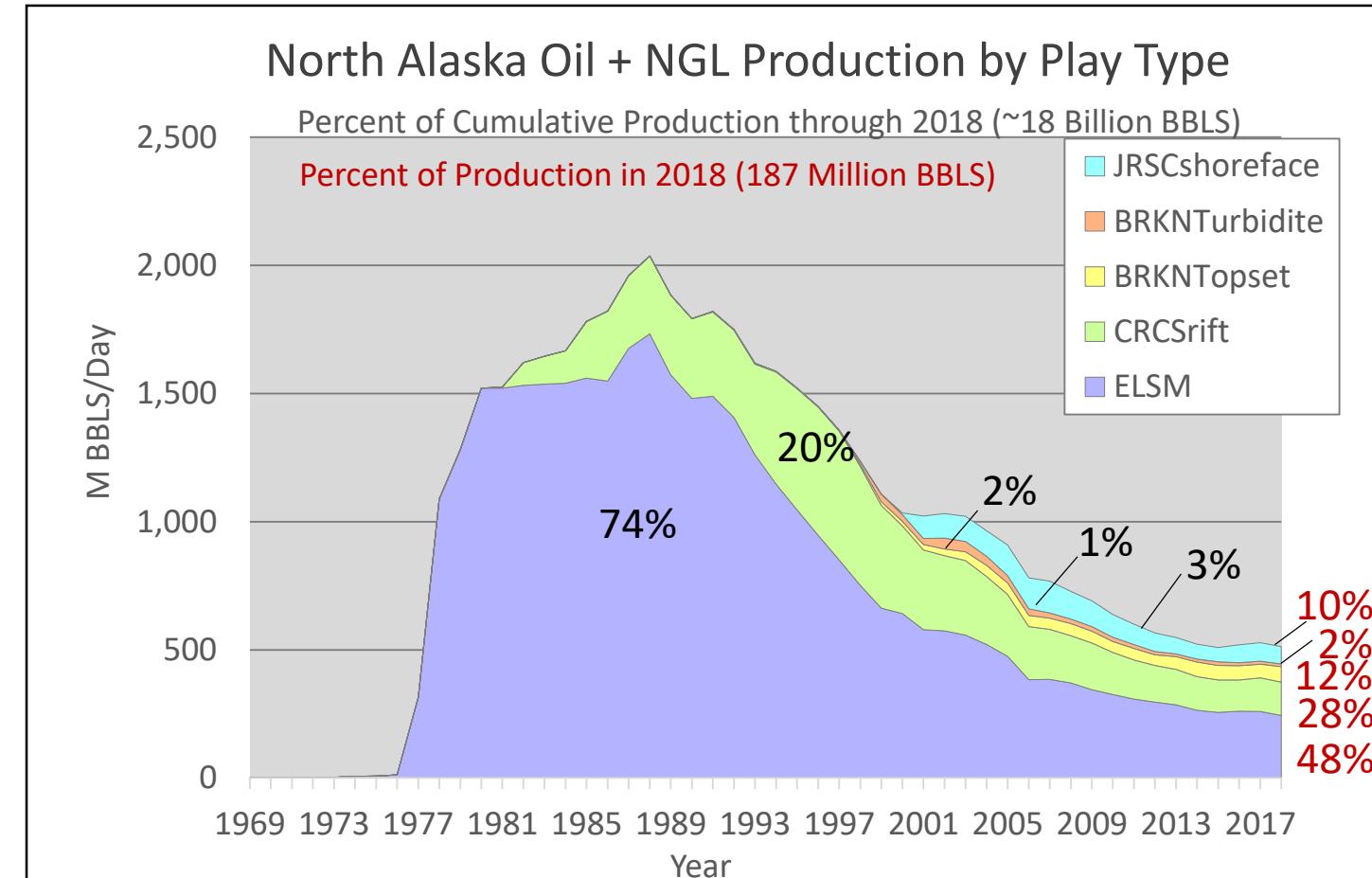
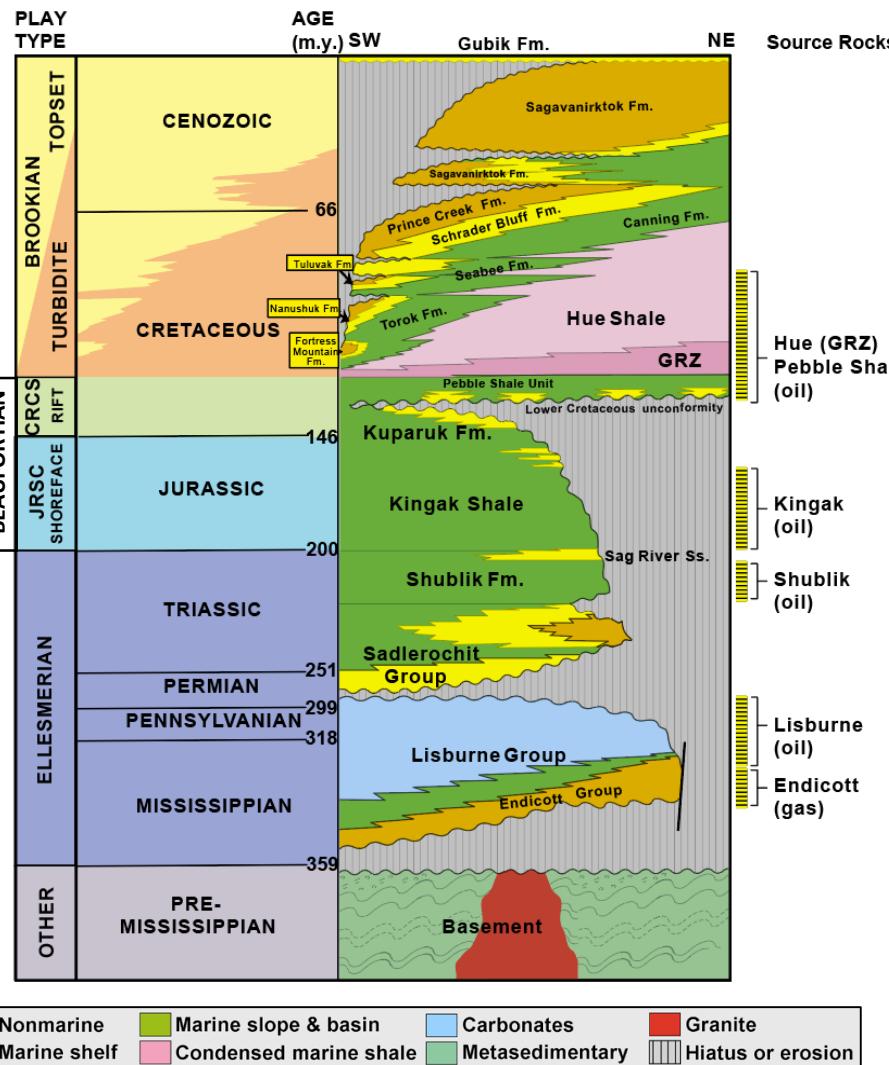
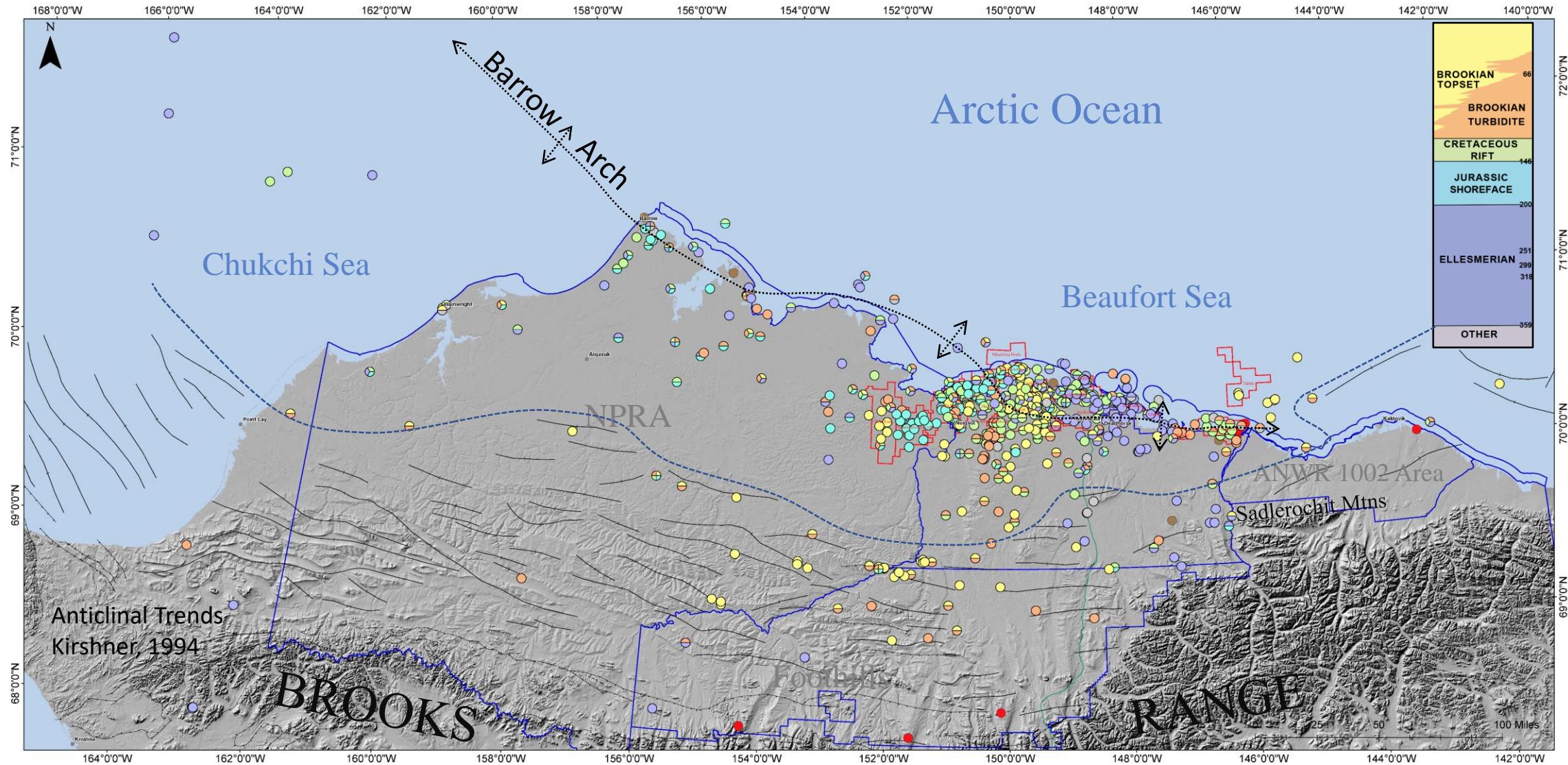


Figure modified from Houseknecht and Bird, 2006;
Garrity and others, 2005; and AKDOG.

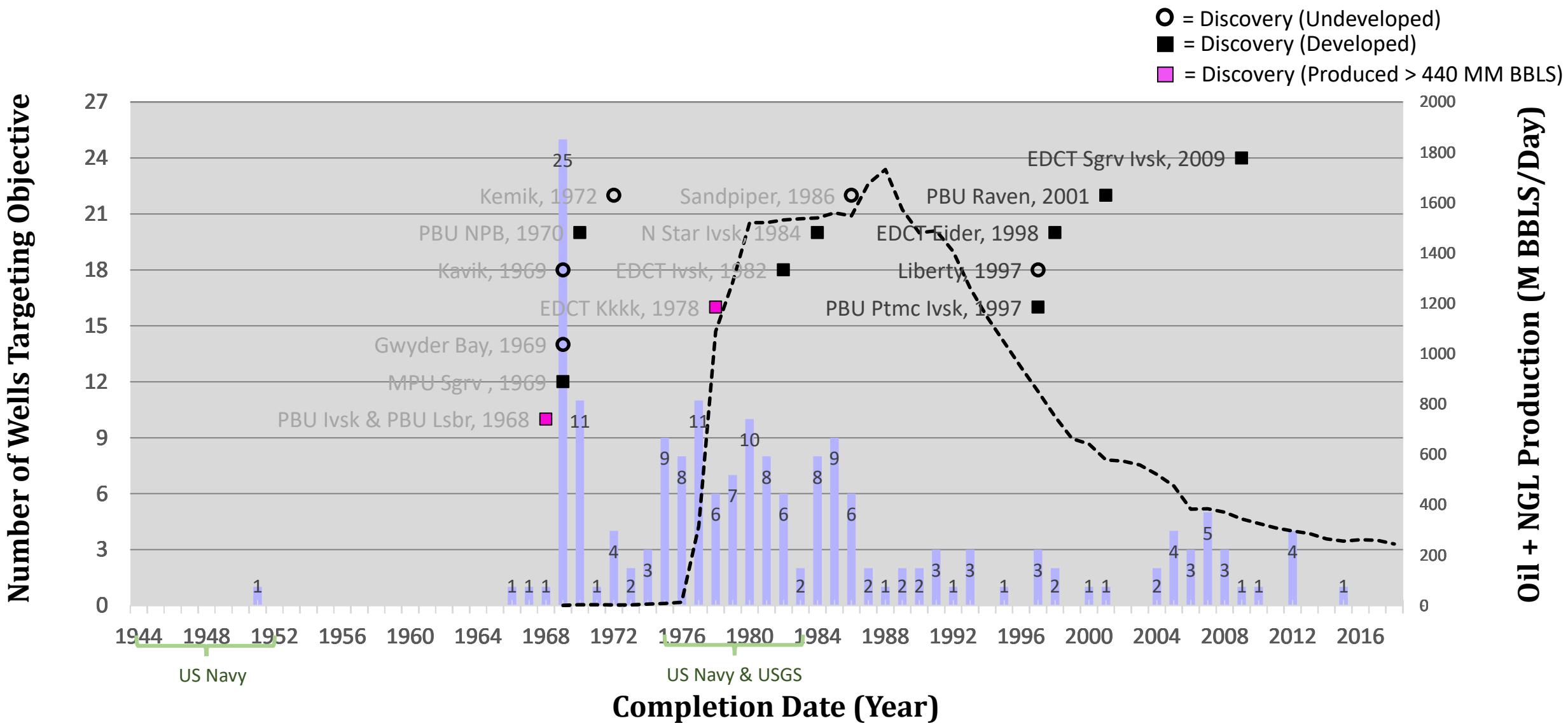
Data source: AOGCC; AKDOG

EXPLORATION DRILLING TARGETS – ALL CATEGORIES - AND REGIONAL TECTONIC ELEMENTS -



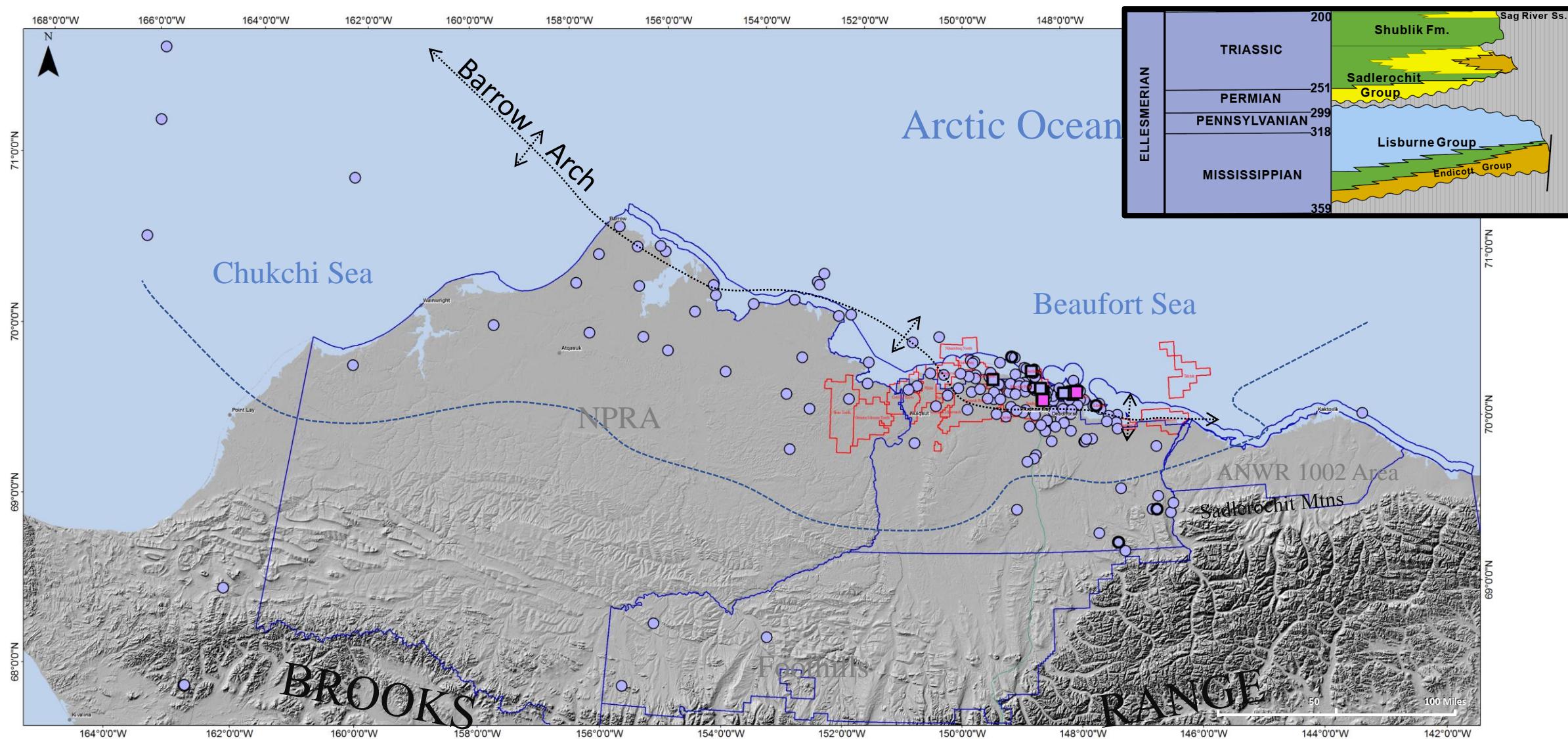
EXPLORATION TARGETS AND DISCOVERIES

- ELLESMERIAN CLASTICS AND CARBONATES -



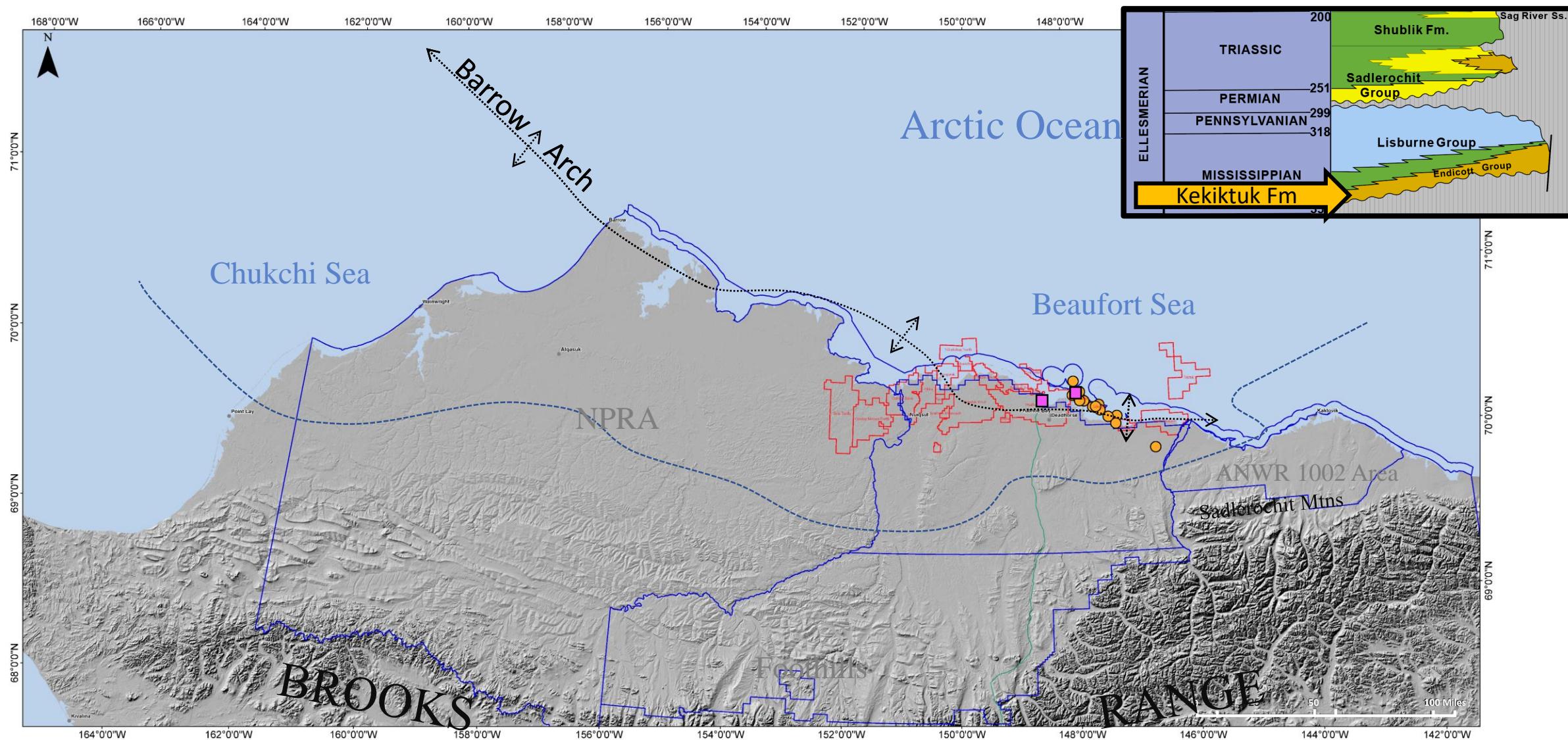
ELLESMERIAN EXPLORATION TARGETS

- CLASTIC AND CARBONATE DEPOSITION ON A STABLE SHELF -



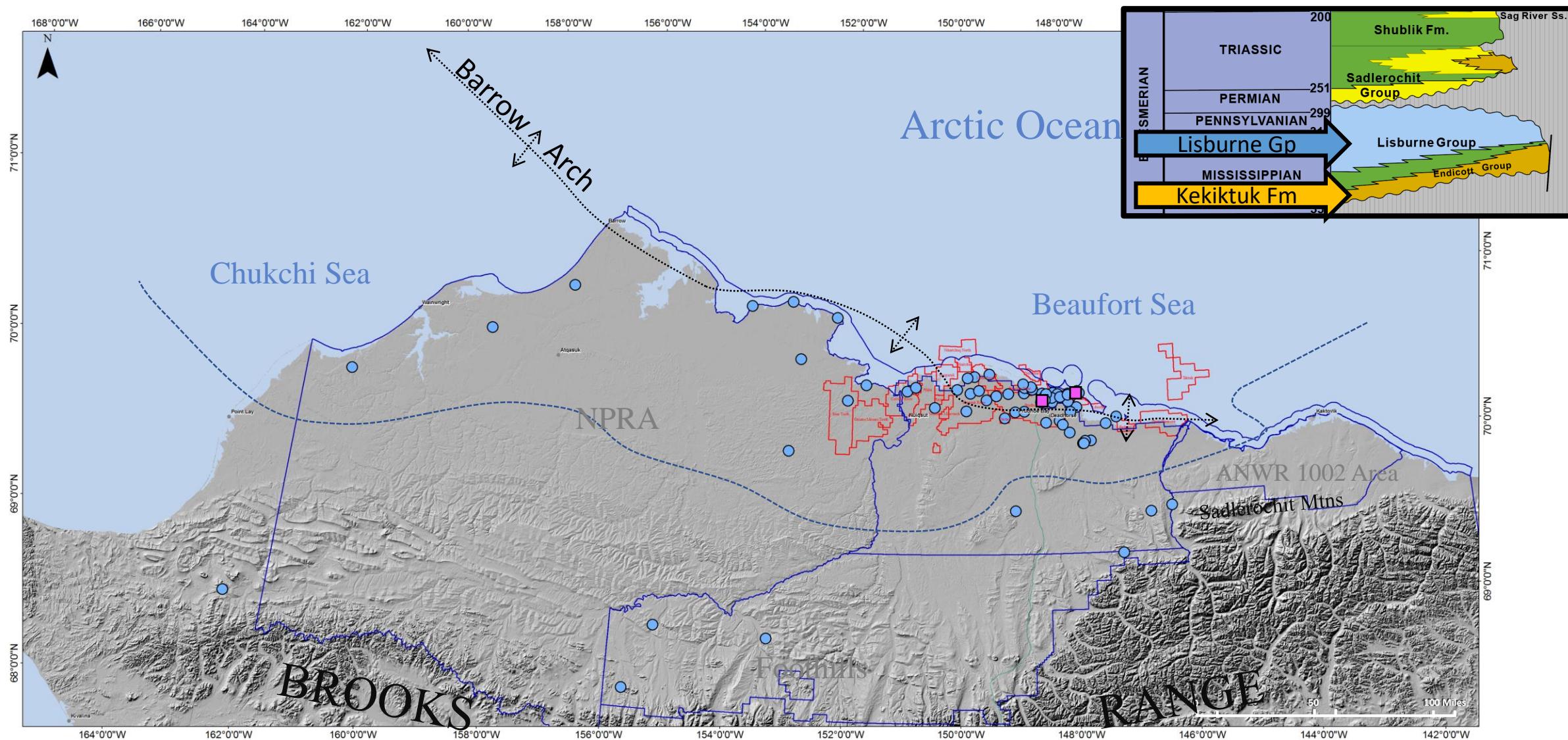
ELLESMERIAN EXPLORATION TARGETS

- KEKIKTUK FORMATION: NON-MARINE -



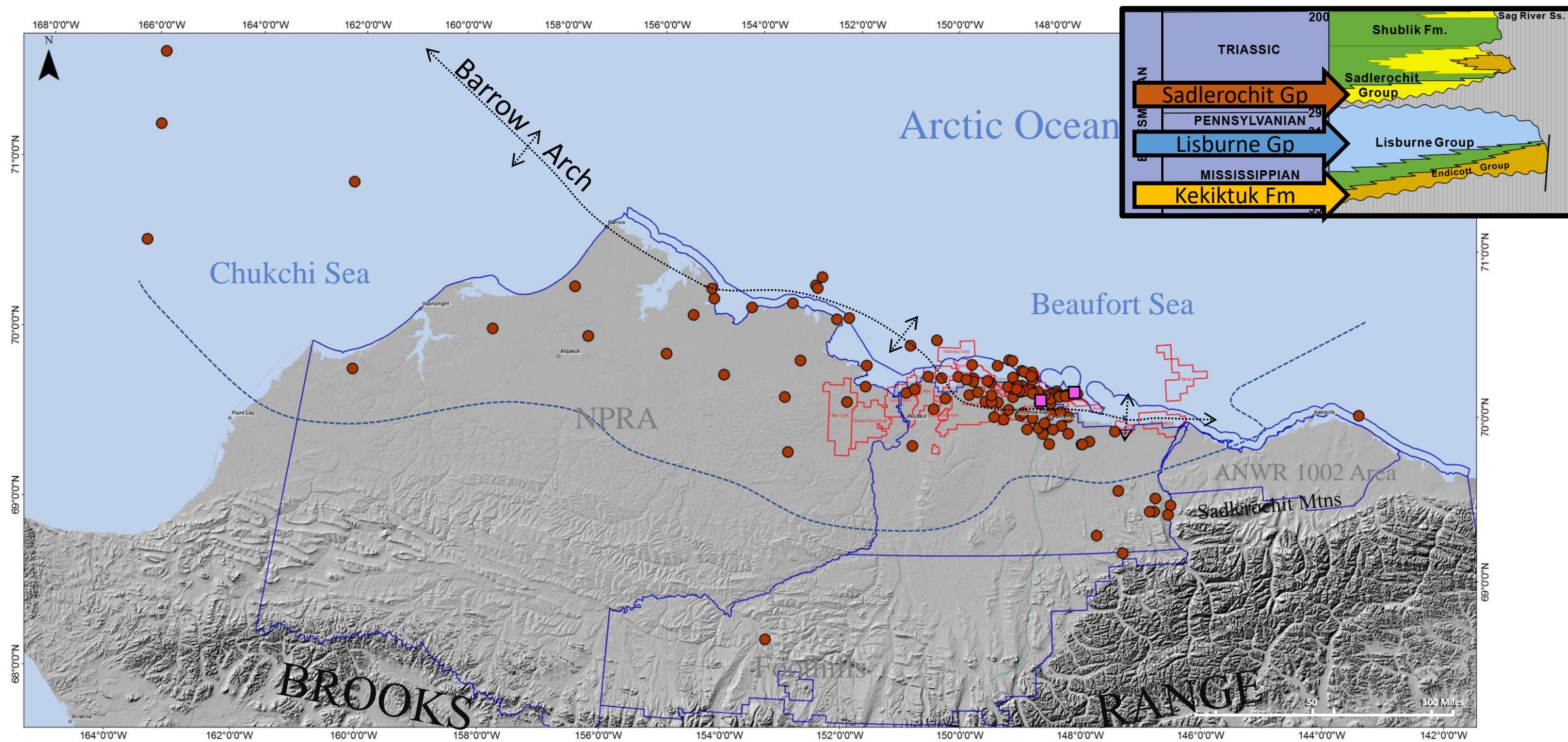
ELLESMERIAN EXPLORATION TARGETS

- LISBURNE GROUP: PLATFORM CARBONATES -



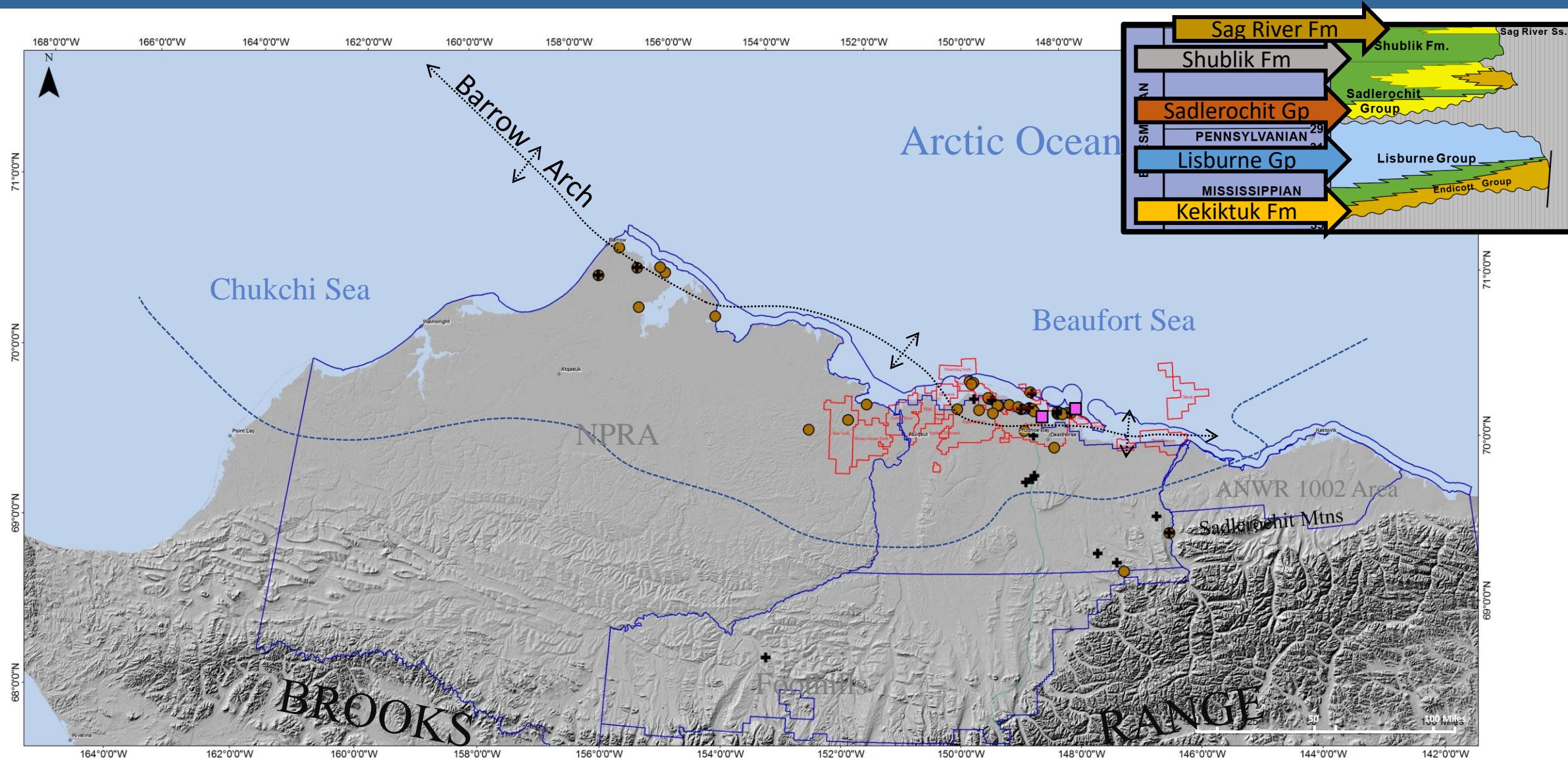
ELLESMERIAN EXPLORATION TARGETS

- SADLEROCHIT GROUP NON-MARINE TO SHALLOW MARINE -



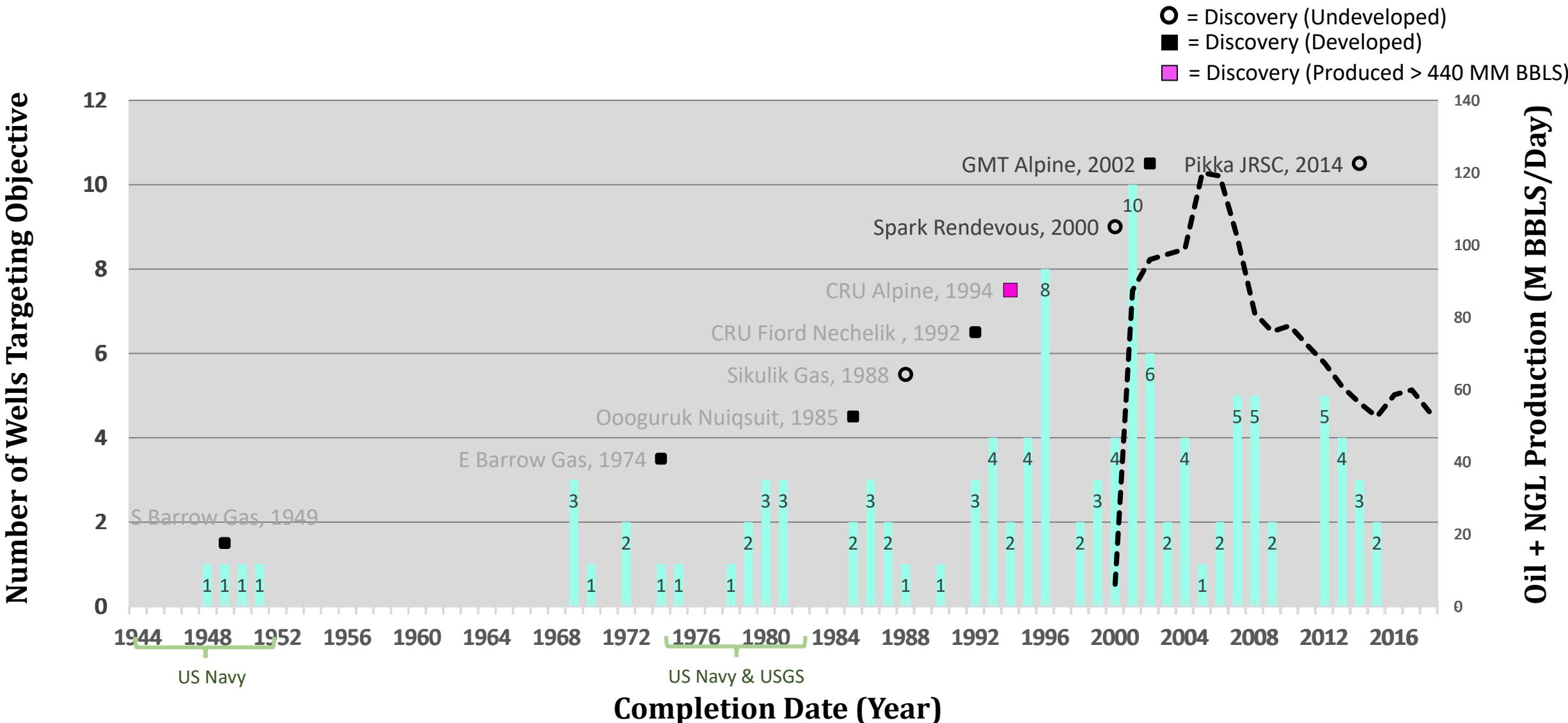
ELLESMERIAN EXPLORATION TARGETS

- SHUBLIK AND SAG RIVER FORMATIONS: MARINE -



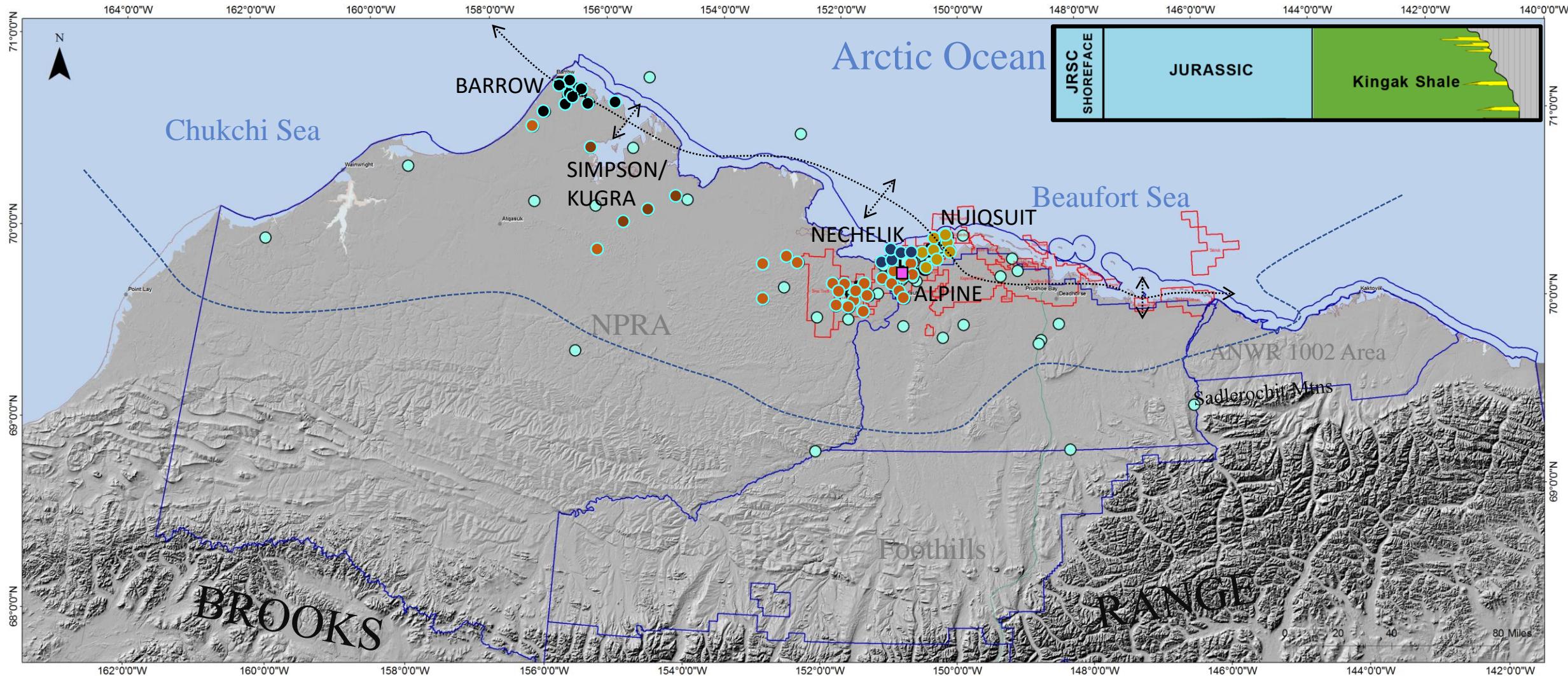
EXPLORATION TARGETS AND DISCOVERIES

- JURASSIC SHOREFACE -



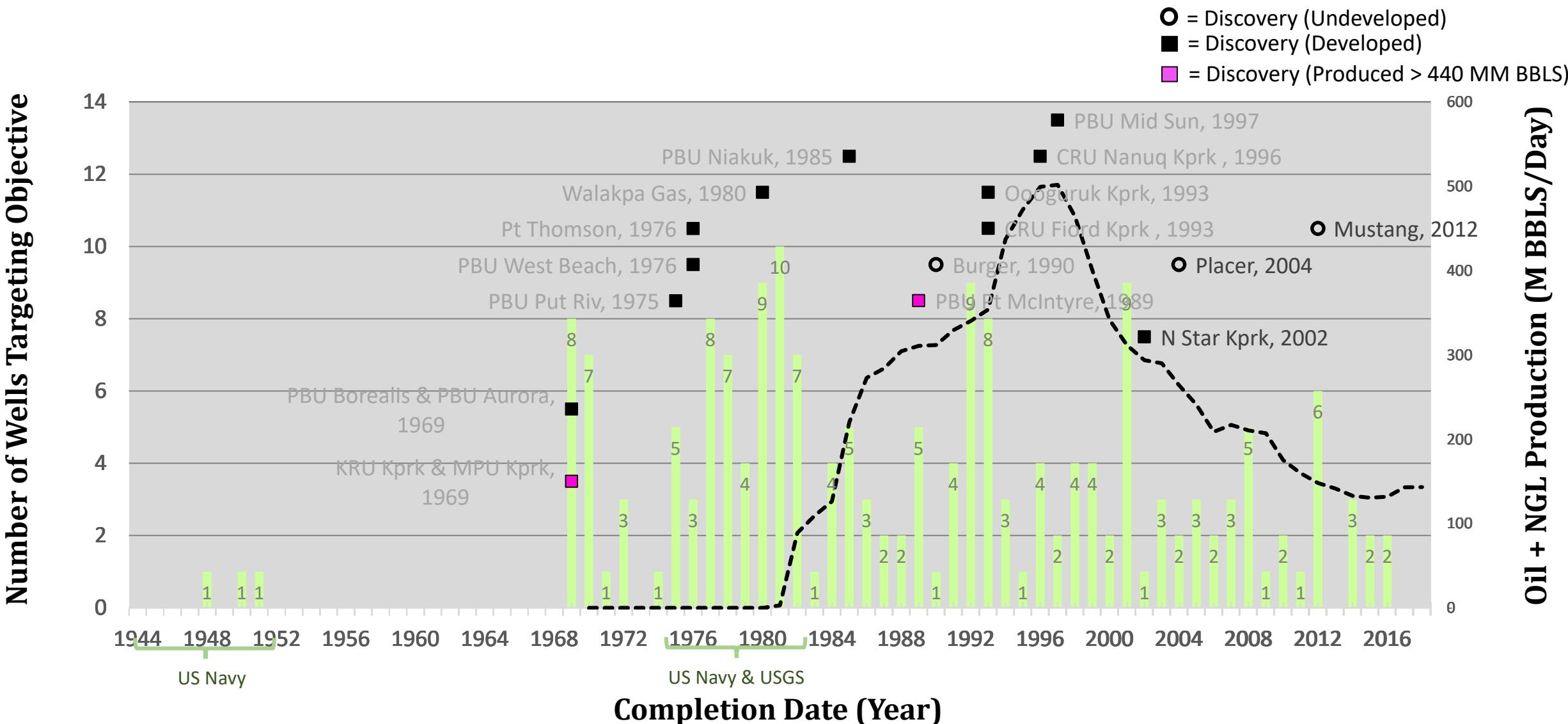
JURASSIC SHOREFACE EXPLORATION TARGETS

- EARLY RIFTING: OPENING OF ARCTIC OCEAN -



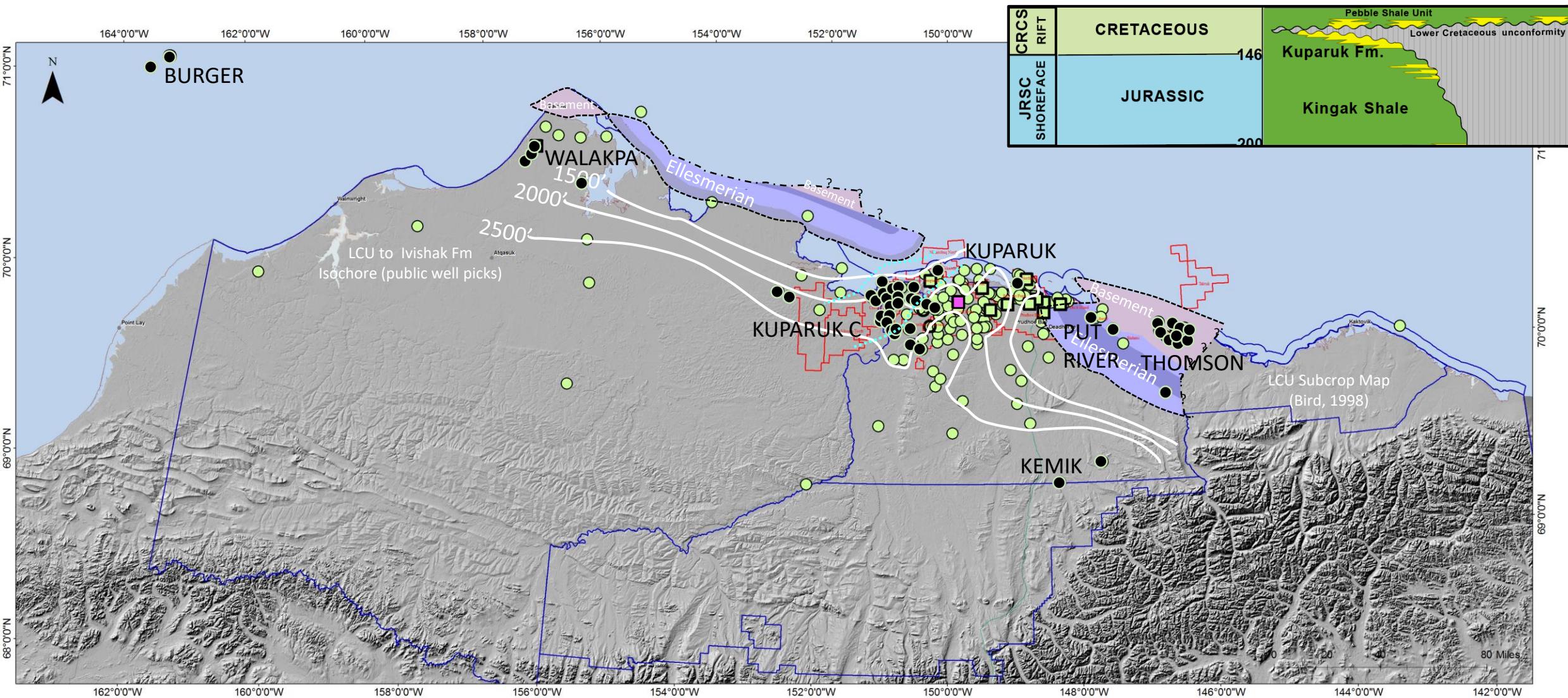
EXPLORATION TARGETS AND DISCOVERIES

- CRETACEOUS RIFT -



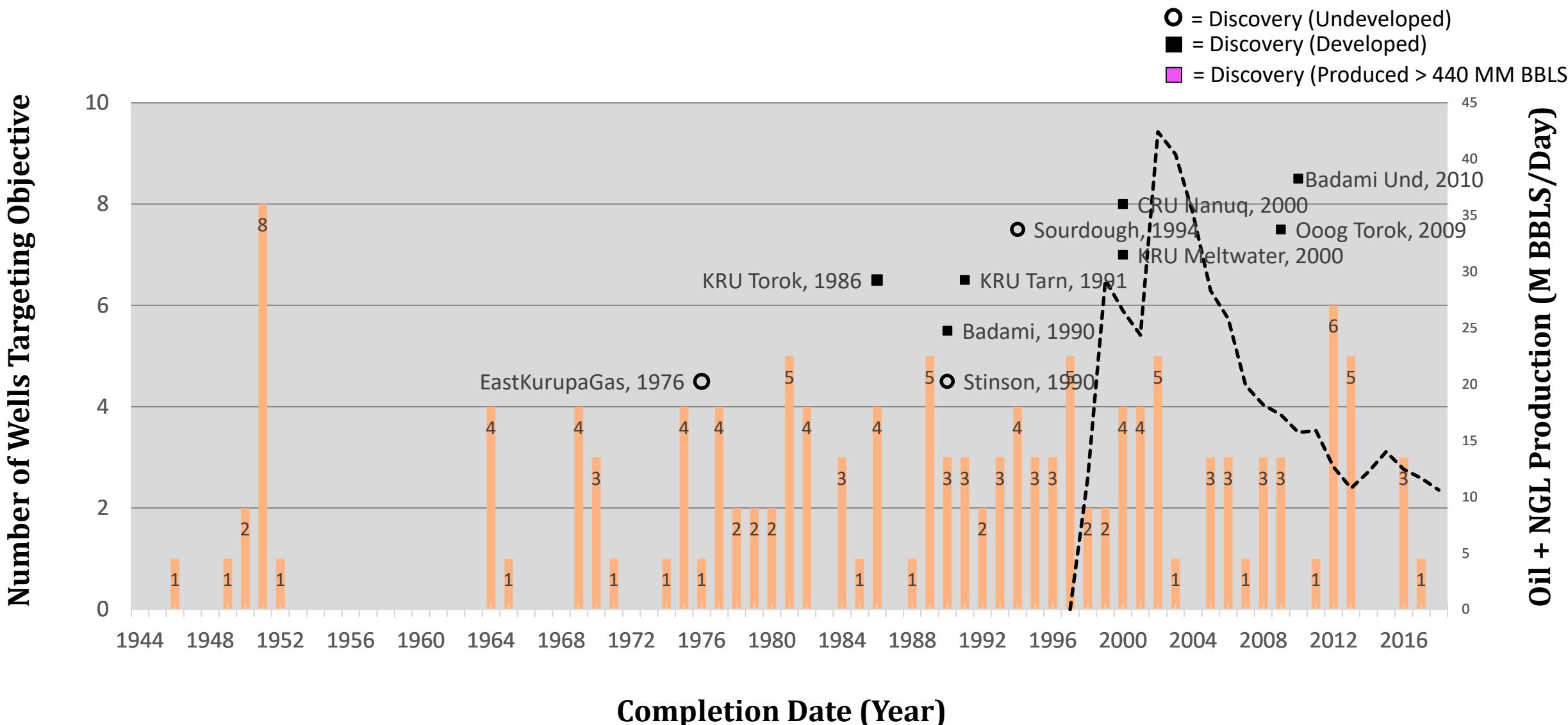
CRETACEOUS RIFT EXPLORATION TARGETS

- CONTINUED RIFTING AND UPLIFT OF BARROW ARCH -



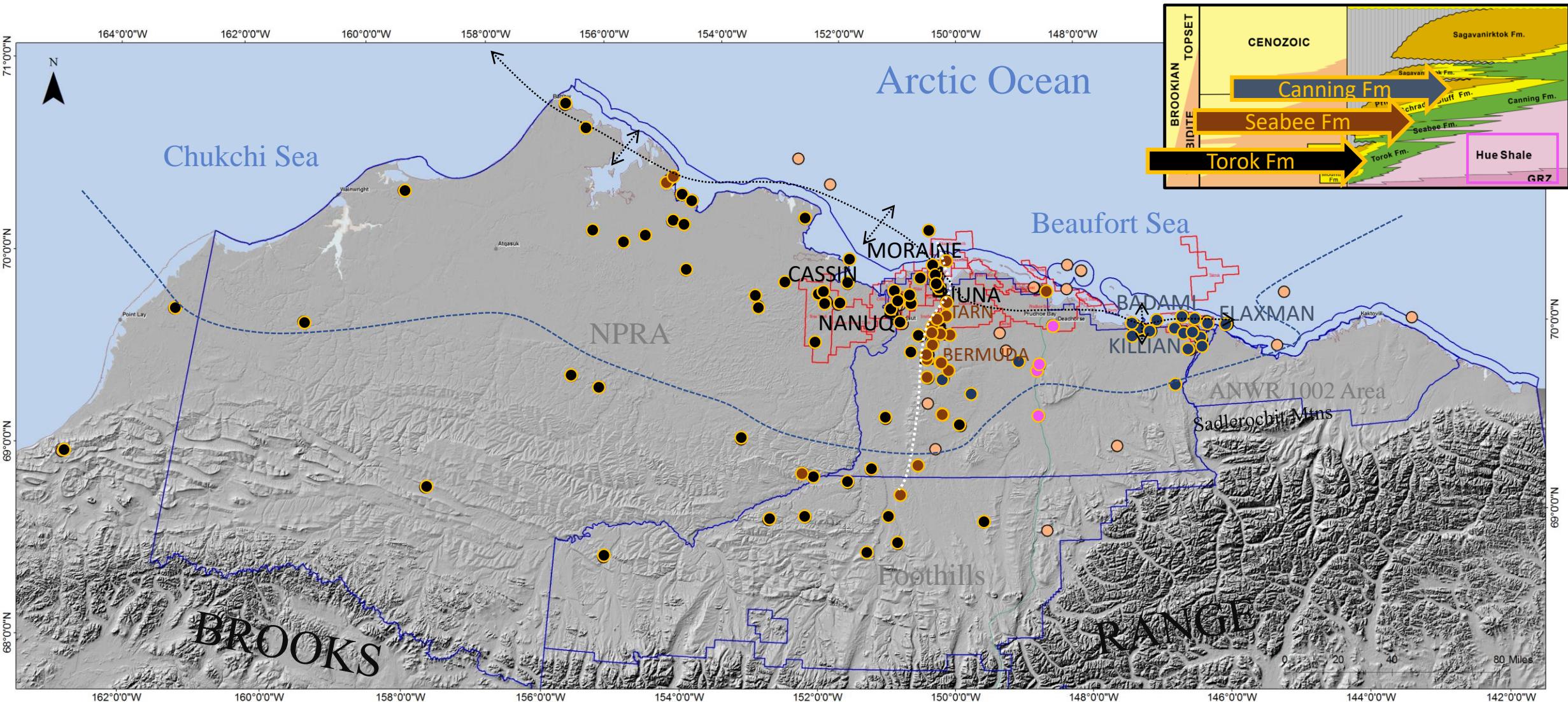
EXPLORATION TARGETS AND DISCOVERIES BY YEAR

- BROOKIAN TURBIDITE -



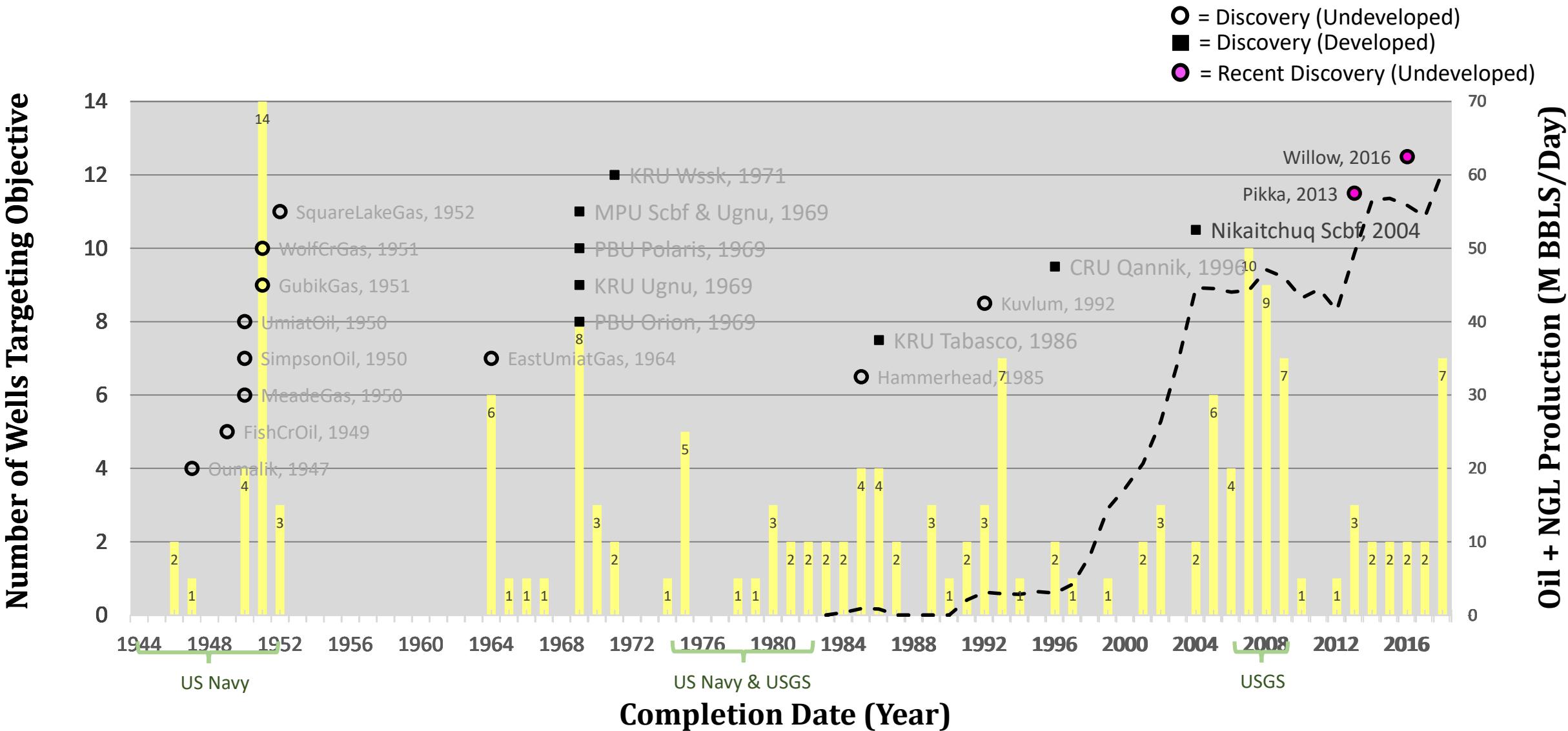
BROOKIAN TURBIDITE EXPLORATION TARGETS

- FILLING IN COLVILLE TROUGH: PRO-DELTA TO DEEP MARINE -



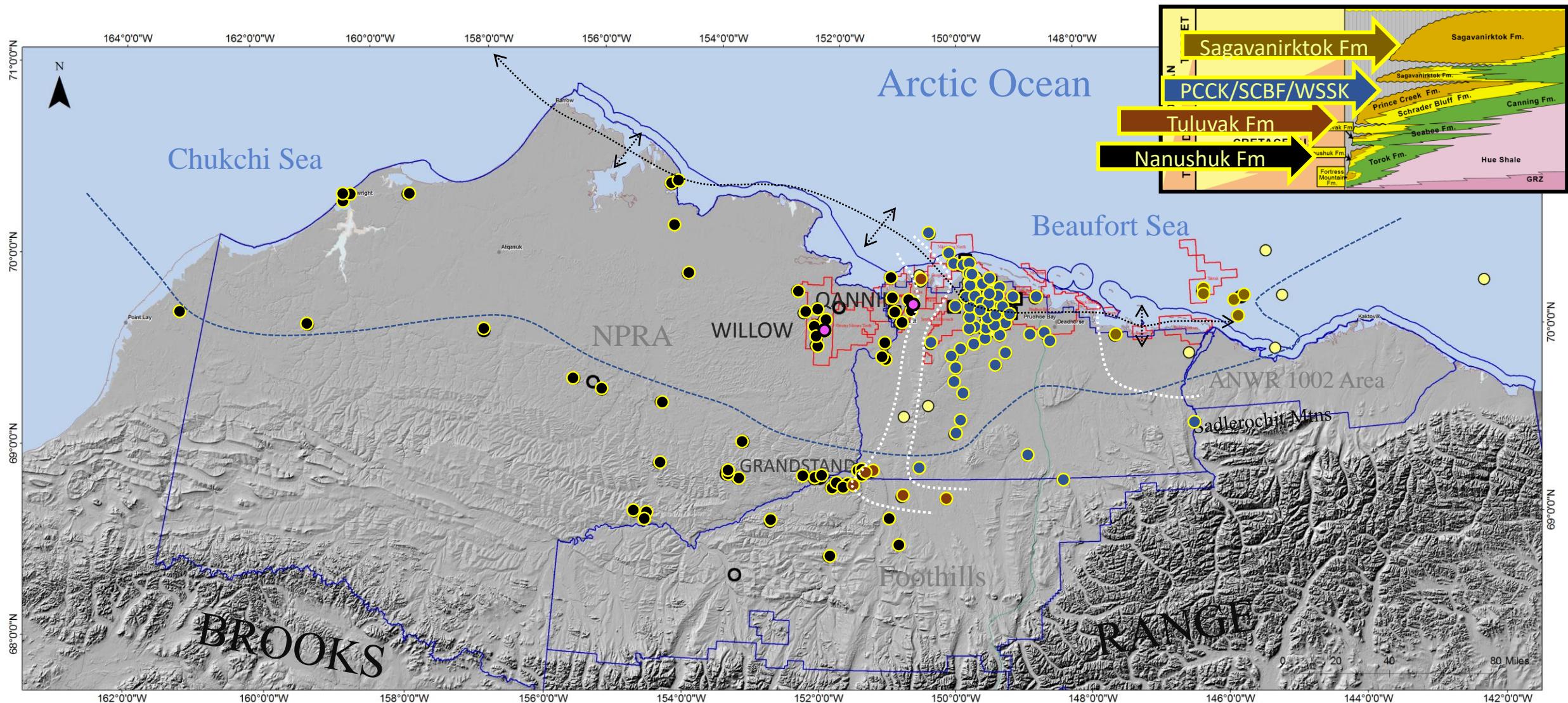
EXPLORATION TARGETS AND DISCOVERIES

- BROOKIAN TOPSET -



BROOKIAN TOPSET EXPLORATION TARGETS

- COEVAL NON-MARINE, SHALLOW MARINE, AND DELTA -

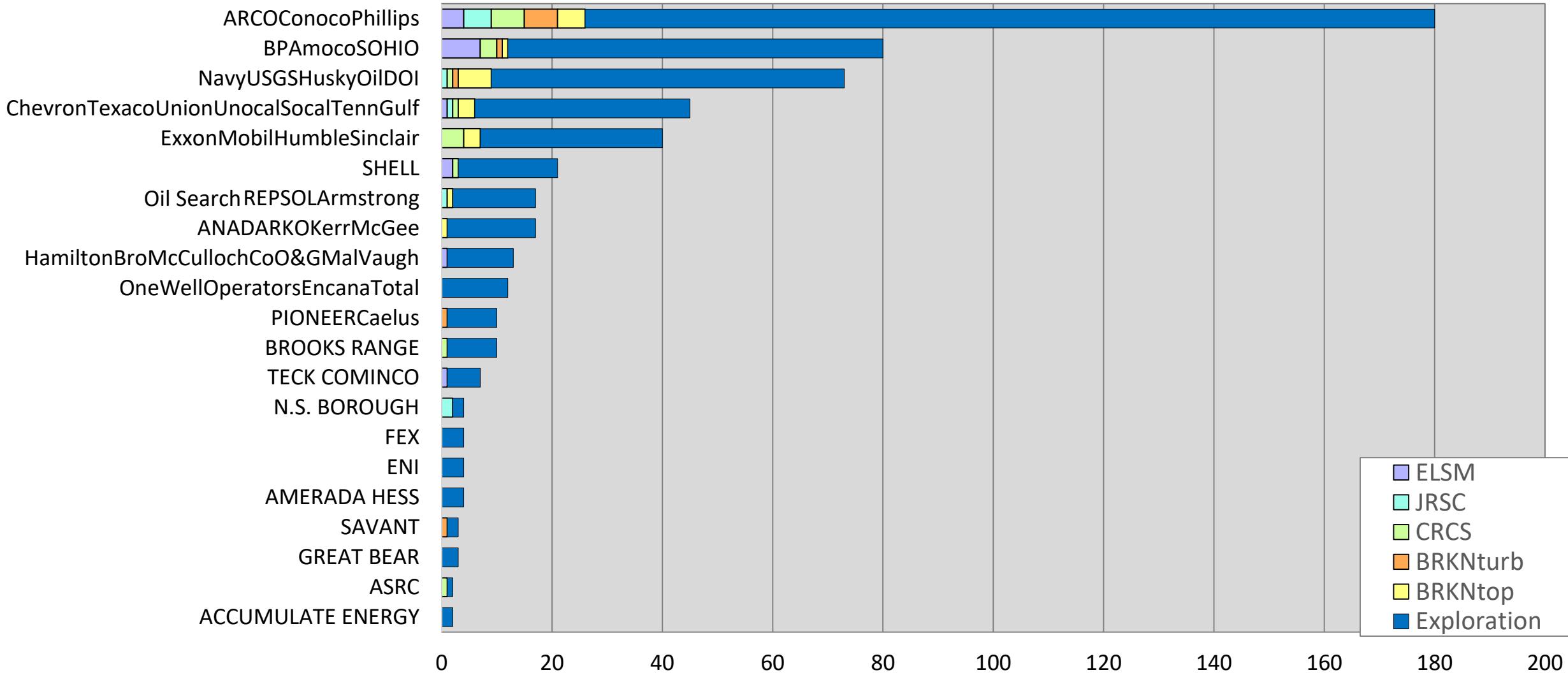


EXPLORERS AND DISCOVERERS

- ALASKA THANKS YOU -

Explorer

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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