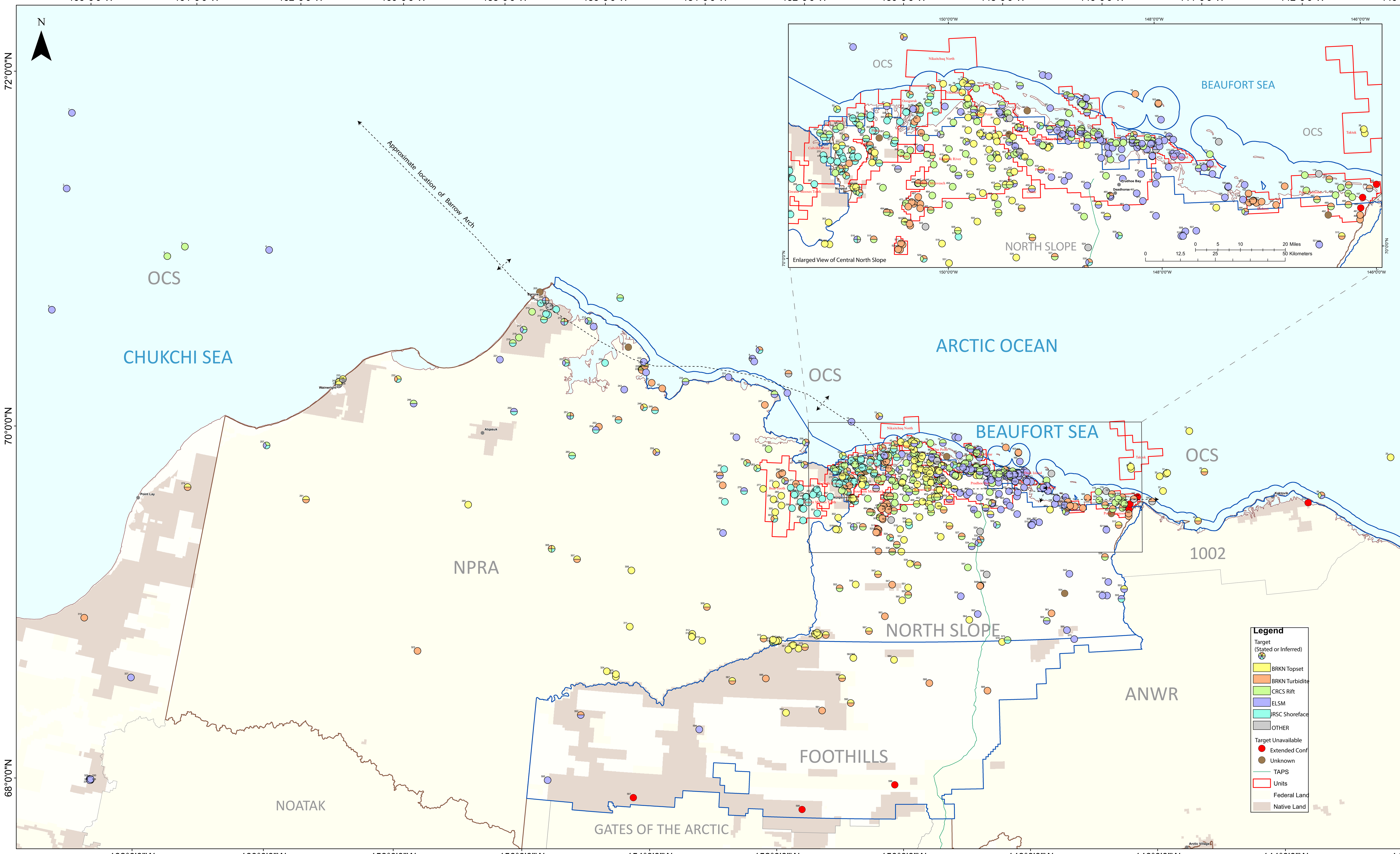
Map #	API #	Well Name	Status	BRKNtop	BRKNturb	CRCSrift	JRSC	ELSM	OTHER	Public Source
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Table of Exploration Targets Categorized by Play Type

There are multiple abbreviations in this table. They include: Zz = Production Pool, Disc = Discovery well; INF = inferred target; YES = directly stated target; NO = target not available publicly; WTS = well test and shows stated publicly; PNA = Petroleum News; BOEM, 2018 = BOEM FOIA Request -2018-00218; AOGCC, 2018 = AOGCC Well History or AOGCC Pool Statistics; AKDOG = Alaska Division of Oil & Gas Decision; O&G, 2017 = Oil &Gas Journal, 2017. FP represents the first production within the pool. Some pools have multiple wells at start-up.



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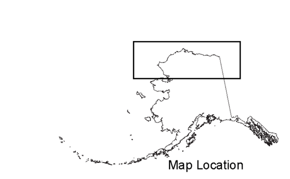

Map and Database of Exploration Drilling Targets Categorized by Play Type, North Slope and Offshore Arctic Alaska

by
Gregersen, L.S.[1] and Brown, G.A.[1]
May 10, 2019

1. Alaska Division of Oil & Gas, 550 W. 7th Avenue, Anchorage, Alaska 99501, USA
laura.gregersen@alaska.gov and garrett.brown@alaska.gov

Coordinate System: NAD_1983_StatePlane_Alaska_4_FIPS_5004_Feet

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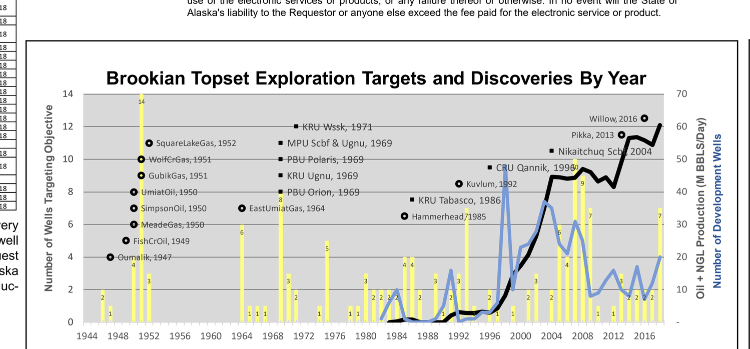

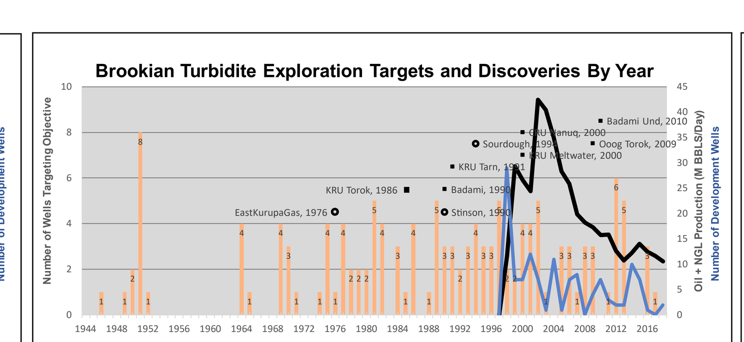

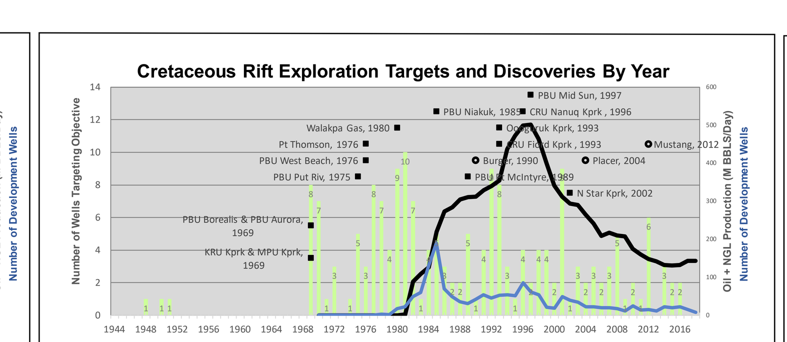

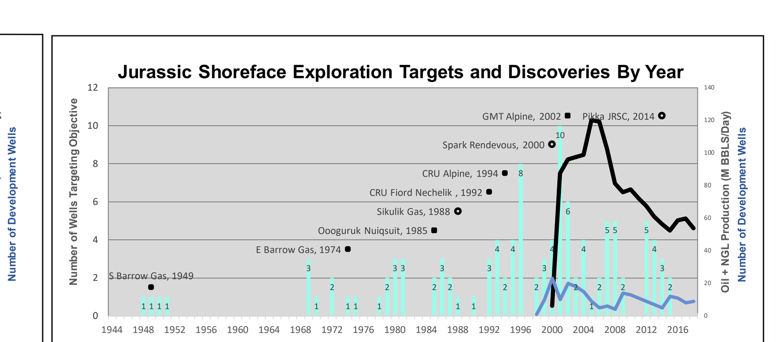

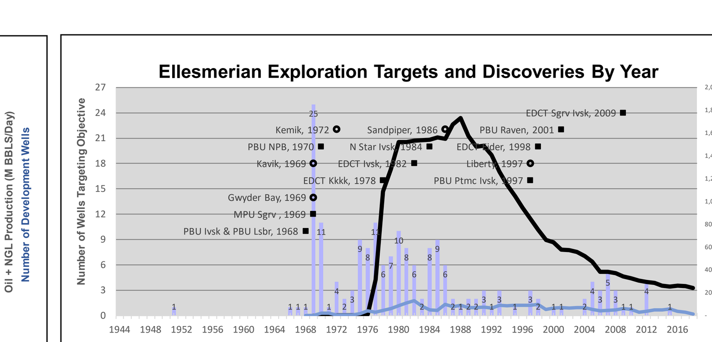

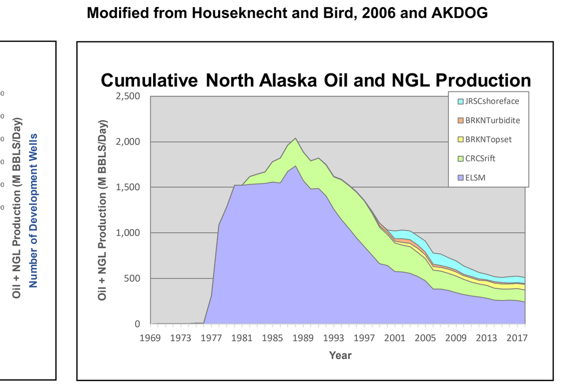

EXPLANATION

This map (Sheet 1) shows the drilling targets categorized by play type 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 this study to address key exploration questions, such as: What wells targeted this play? Where are the producing analogues? How much oil has this play produced? Who successfully or unsuccessfully targeted this play in the past?

Individual maps of Ellesmerian sequence targets (Kekiktuk Formation, Lisburne Group, Sadlerochit Group, Shublik Formation, and Sag River Formation) are found on Sheet 2. Individual maps of Beaufortian sequence targets (Jurassic shoreface and Cretaceous rift) are found on Sheet 3, and individual maps of Brookian sequence targets (Brookian turbidites and Brookian topsets) are found on Sheet 4.

Since exploration drilling began on the North Slope of Alaska in 1944, numerous oil and gas accumulations have been discovered and 18 billion barrels of liquid hydrocarbons have been produced from North Alaska through 2018 (AOGCC, 2018). Recently announced +0.5 – 1 billion-barrel oil discoveries in the Brookian topset play exemplify the potential remaining in this basin.

Data

All exploration target data integrated into this map are from public sources. The primary sources of public domain data are state and federal well histories, Alaska Division of Oil and Gas unit decisions, Petroleum News articles, Alaska industry news articles, federal well summary reports, and lessee press releases.

The drilling targets are explicitly stated for 346 wells. 161 wells are inferred from data such as core and drill stem tests. Eight wells are held under extended confidentiality with an unknown release date due to the status of acreage within a three-mile radius of the well. Twenty-one wells are explicitly stated as a well test or show. Eleven wells were unable to be determined from the publicly available data.

The authors completed an extensive review process in which each exploration target and cited reference was checked. If the target was directly stated or the inferred target could be deduced from the supporting public data, then the target would get placed into a play type category. Otherwise, further research was conducted to find a satisfactory drilling target. A companion spreadsheet (.xlsx file) containing drilling target data, hyperlinks to the cited references for that data, and page numbers on which the drilling target information was found is available here: http://dog.dnr.alaska.gov/Information/Studies.

Interpretation of Play Type Categories

Exploration wells have targeted five main stratigraphic play type categories: 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, methane hydrates, and coal bed methane). Multiple subgroupings may exist within each play type; however, the goal of this project was to provide generalized 'geologic' filters to exploration and production data in north Alaska. Federal oil and gas resource assessments by the United States Geological Survey (USGS) and Bureau of Ocean Energy Management (BOEM) (formally Minerals Management Service MMS) have been using these play type categories for many years. A table defining the abbreviation code of each exploration target name and its designated play type category is included on each sheet.

The map of exploration drilling targets highlights the spatial distribution of each play type. Exploration wells targeting the Ellesmerian, the largest contributor of oil production, systematically cover a region that extends from the Chukchi Sea, through northern NPRA, and across the northern portion of the central North Slope. Wells are both onshore and in the Beaufort Sea. Other Ellesmerian targets are found in the east-central North Slope sale region and the foothills of the Brooks Range. A small cluster of natural gas wells targeting the Kivalina Member of the Kuna Formation are within the Brooks Range at the Red Dog Mine. The wells targeting the Jurassic cover a region from onshore northwest NPRA to the west central region of the North Slope. The wells targeting the Cretaceous rift sands are found in the Chukchi Sea and within a seventy-five-mile swath that extends from northwest NPRA to the western border of ANWR. The greatest concentration of Cretaceous rift targets is in the north central North Slope. Wells targeting Brookian turbidites and Brookian topsets cover the northern and central regions of NPRA, the central North Slope, and the foothills of the Brooks Range. In both Brookian plays, north-south trending lines of exploration wells delineate shelf margins. Exploration wells targeting both Brookian play types are found in the Beaufort Sea west and north of ANWR.

Each one of the five play types have contributed to oil production on the North Slope of Alaska. A water fall chart showing oil and natural gas liquid production as categorized by play type highlights the fact that the Ellesmerian reservoirs have been the primary contributors to production. The Cretaceous rift reservoirs are secondary followed by the Jurassic shoreface reservoirs, Brookian topsets, and Brookian turbidites. Individual charts for each play type show the annual exploration well count, development well count, discovery date, and annual oil production rate. The discoveries that have been put into production are symbolized by closed squares and the undeveloped discoveries are symbolized by open circles.

Error and Uncertainty

All sources of data for this study are found in the public domain. The authors did not incorporate any exploration drilling target information from confidential sources. For this reason, this database may be missing exploration drilling targets that the operator had as an objective but did not report in publicly available records. Drilling target inferences made from core or drill stem tests relied upon publicly available formation tops within publicly available well histories as well as the formation picks available at the Alaska Division of Geological and Geophysical Surveys Geologic Materials Center. One of the most challenging targets to put into a play type category is Cretaceous. Multiple play type categories are Cretaceous in age. The authors used their best judgement from the well history data and understanding of the regional geology when placing a Cretaceous drilling target into a play type category.

The discovery date for each producing field is sourced from the AOGCC pool rules. Most of the discovery dates for the undeveloped accumulations come from Thomas and others, 2007 and Petroleum News articles. The authors recognize that there was a judgement call made by the public source as to what well actually discovered the undeveloped accumulations. There also may be many more accumulations that have been found by exploration wells that have not been announced publicly. These are not included in this study.

The companion database provides a link and a page number to each public source our exploration target is based upon. Because the AOGCC updates its online well history files, the page number within the well history file changes. Most of the exploration wells were completed long ago so they will not be receiving updates to the well files. When looking up more recent wells, the page number may be off.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge Kelsey Anderson and Joseph Skutca for their early contributions to the exploration target research in NPRA and state lease sale regions. The authors also gratefully acknowledge Kirk Sherwood for guiding us through the federal data request process for Outer Continental Shelf (OCS) well data. Significant improvements were made to the map from feedback and discussions with Kirk Sherwood, Paul Decker, Don Krouskop, Steve Moothart, Kevin Frank, Ken Helmold, Dave LePain, Dan Seamount, Steve Davies, Meredith Guhl, David Boyer, Yelena Young, and Sean Clifton. The map benefited from cartographic expertise provided by Sean Conlon and Marta Mueller.

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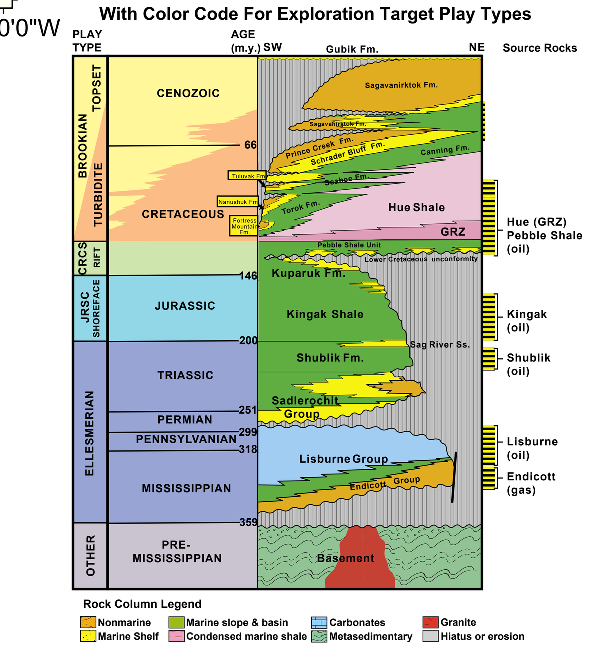
GENERALIZED STRATIGRAPHIC COLUMN

With Color Code For Exploration Target Play Types



Modified from Houseknecht and Bird, 2006 and AKDOG

Exploration Target Abbreviations

Hydrate	Gas Hydrate Stability Zone
SVKK	**Sagavanirktok Formation**
CNNG	**Canning Formation**
FLAX	Flaxman Sandstone
BDAM	Badami Sandstone
KILLIAN	Killian Sandstone
PCCK	**Prince Creek Formation**
KGKK	Kogosurkruk tongue of Prince Creek abandoned
UGNU	**Ugnu Sandstone**
SCBF	**Schrader Bluff Formation**
SLHL	Sentinel Hill Mbr of Schrader Bluff abandoned
BRTL	Barrow Trail Mbr of Schrader Bluff abandoned
WSSK	West Sak Sandstone
TLVK	**Tuluvak Formation**
SEBE	**Seabee Formation**
AYYK	Ayiyak Mbr of Seabee Formation abandoned
TARN	Tarn Sandstone
ICEBERG	Iceberg Sandstone
ARETE	Arete Sandstone
CAIRN	Cairn Sandstone
BRMA	Bermuda Sandstone
NNSK	**Nanushuk Formation**
NNLK	Ninuluk Formation abandoned
CDLR	Chandler Formation abandoned
GRDD	Grandstand Formation abandoned
TUKT	Tuktu Formation abandoned
WILLOW	Willow Sandstone
QNNK	Qannik Sandstone
K2	Brookian K2 Marker
TOROK	**Torok Formation**
ALBN	Albian Top
NANUQ	Nanuq Sandstone
MORAINE	Moraine Sandstone
OMLK	Nuna Sandstone
NUNA	Oumalik Formation abandoned
TPGK	Topogoruk Formation abandoned
FRTR	**Fortress Mountain Formation**
HUE	**Hue Shale**
HRZ	**HRZ**
PBLS	**Pebble Shale**
KLBK	Kalubik Formation
PTRR	Put River Sandstone
THOM	Thomson Sandstone
KEMIK	Kemik Sandstone
KPRK	**Kuparuk Formation**
WLKP	Walakpa Sandstone
KNGK	**Kingak Shale**
ALPN	Alpine Sandstone
NUIQ	Nuiqsut Sandstone
NECH	Nechelik Sandstone
SIMP	Simpson Sandstone
KUGRUA	Kugrua Sandstone
BRRW	Barrow Sandstone
J5	Jurassic J5 Marker
J4	Jurassic J4 Marker
SGRV	**Sag River Formation**
SBLK	**Shublik Formation**
EILN	Eileen Formation
SDLC	**Sadlerochit Group**
IVSK	Ivishak Formation
KAVIK	Kavik Shale
ECHK	Echooka Formation
LSBR	**Lisburne Group**
WHOO	Wahoo Limestone
ALPH	Alapah Limestone
EDCT	**Endicott Group**
KAYAK	Kayak Shale
KKKK	Kekiktuk Sandstone
KVLA	Kivalina Mbr of Kuna Formation Red Dog Mine
BSMN	**BASEMENT**
PREMISS	Pre Mississippian
DVNN	Devonian
ARGL	Argillite Basement