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U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

OPEN-FILE REPORT 03-330
Version 1.0

North Alaska Petroleum System Analysis: The Regional Map Compilation

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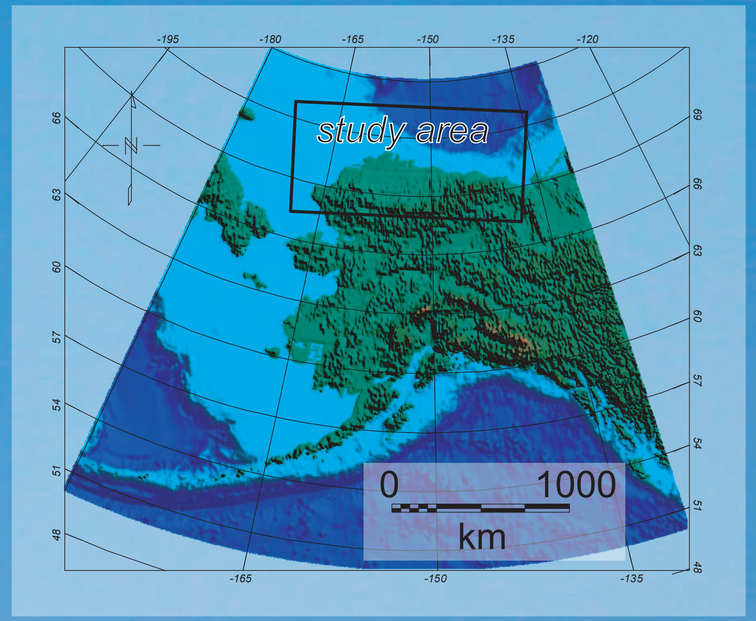
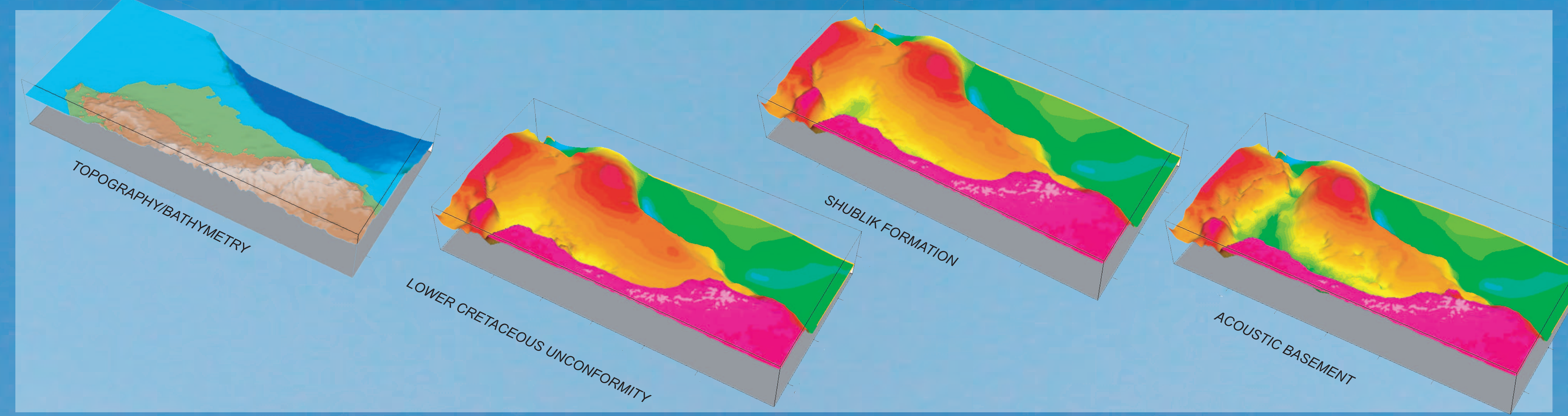
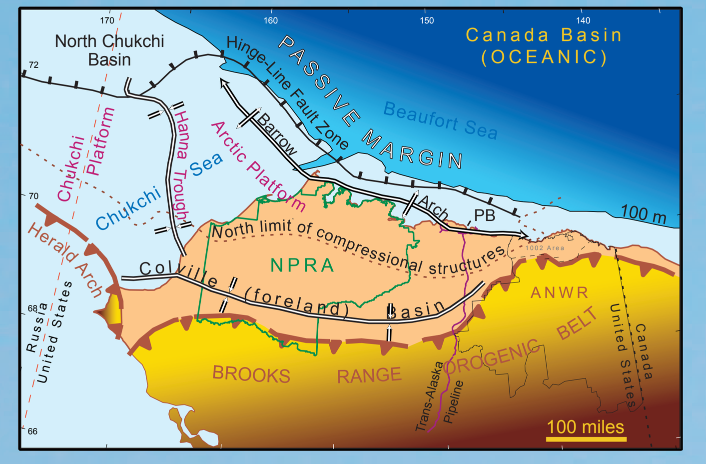
Abstract

The U.S. Geological Survey initiated an effort to model north Alaskan petroleum systems. The geographic and geologic basis for modeling systems is provided by a set of regional digital maps that allow evaluation of the widest possible extent of each system. Accordingly, we laid out a rectangular map grid 1300 km (800 miles) east-west and 600 km (375 miles) north-south. The resulting map area extends from the Yukon Territory of Canada on the east to the Russian-U.S. Chukchi Sea on the west and from the Brooks Range on the south to the Canada basin-Chukchi borderland on the north.

Within this map region, we combined disparate types of publicly available data to produce structure contour maps. Data types range from seismic-based mapping as in the National Petroleum Reserve to well penetrations in areas of little or no seismic data where extrapolation was required. With these types of data, we produced structure contour maps on three horizons: top of pre-Mississippian (basement), top of Triassic (Ellesmerian sequence), and top of Neocomian (Beaufortian sequence). These horizons, when combined with present-day topography and bathymetry, provide the bounding structural/stratigraphic surfaces of the north Alaskan petroleum province that mark major defining moments of the region's geologic history and allow regional portrayal of preserved sediment accumulations.

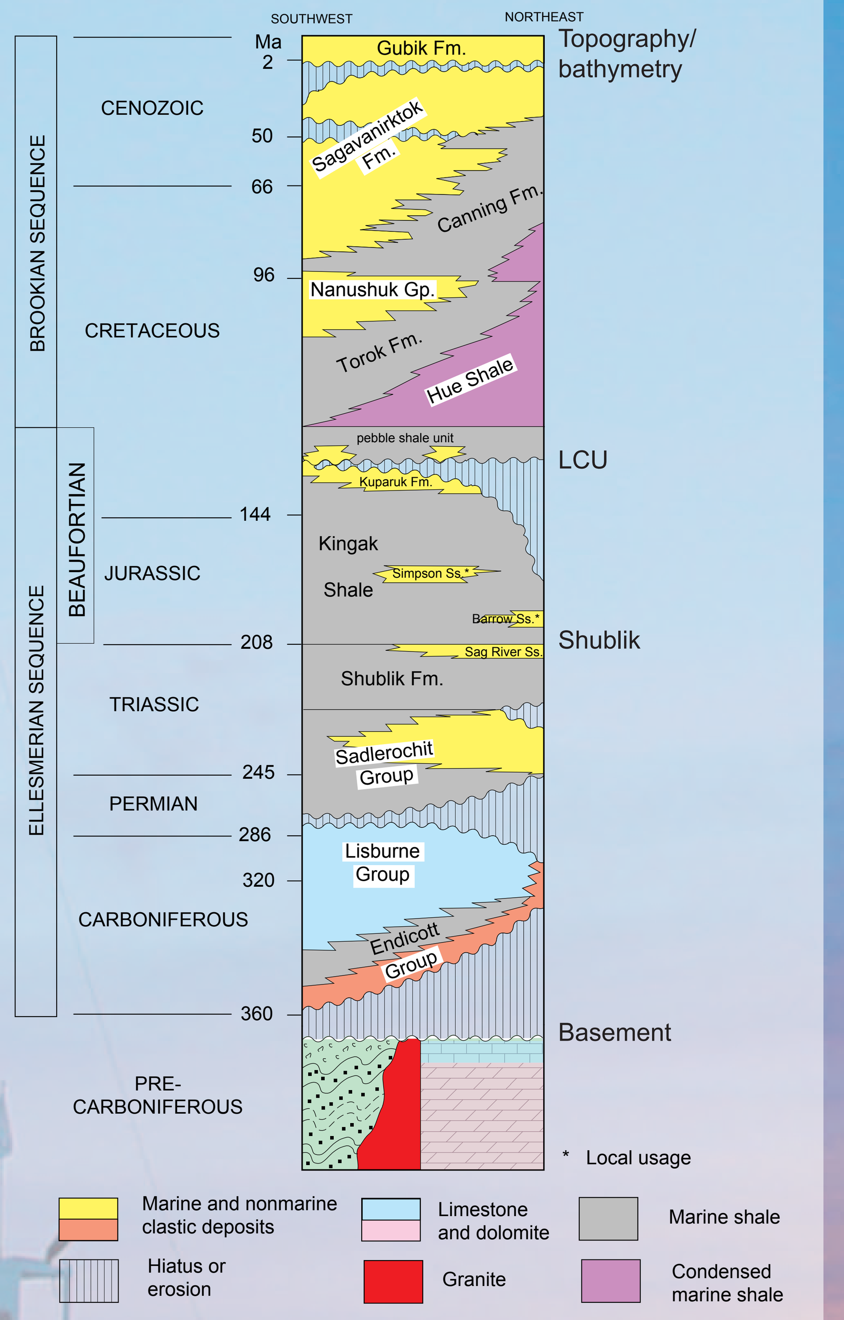


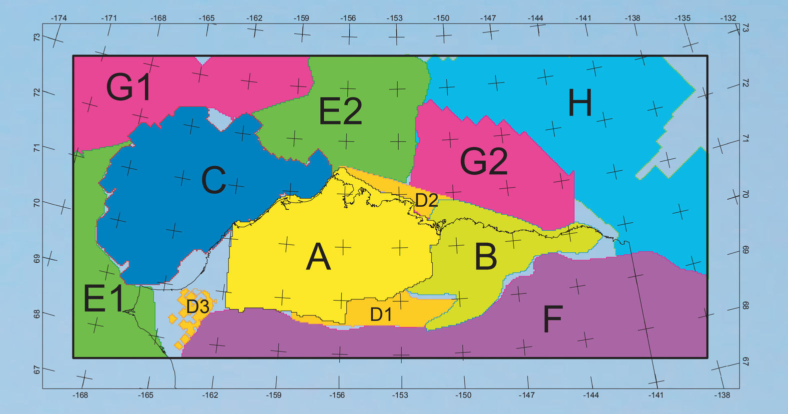




Map shows the location of the National Petroleum Reserve—Alaska (NPRA) relative to the major tectonic features of northern Alaska. ANWR, Arctic National Wildlife Refuge. PB, Prudhoe Bay.

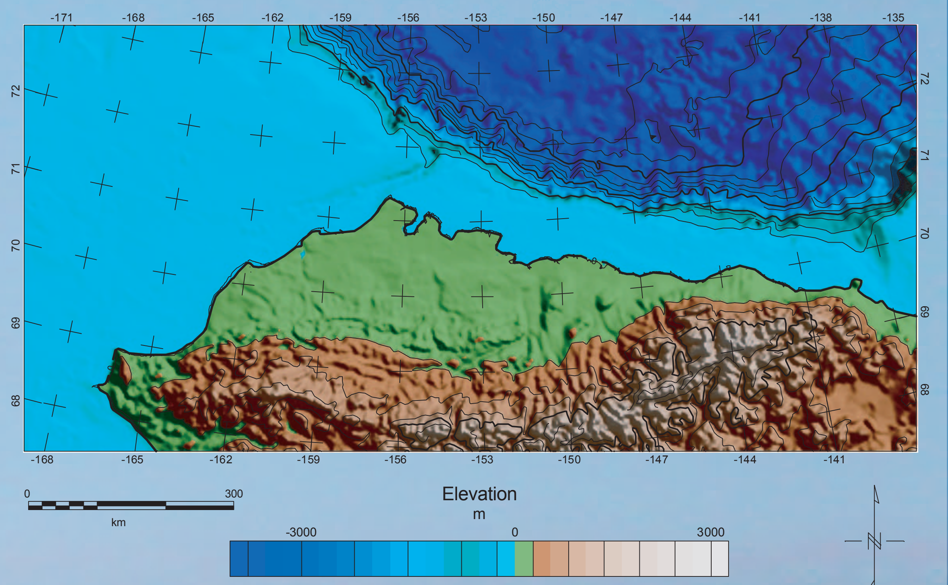
NORTH SLOPE STRATIGRAPHY





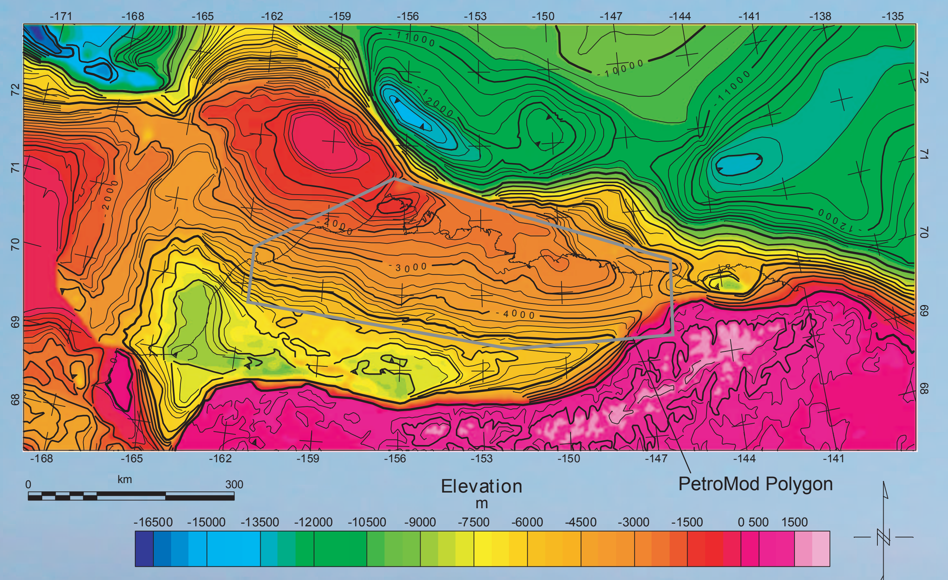
LCU data index map

A. Bruynzeel and others (1982) modified by Saltus and others (2002)
B. ANWR Assessment Team (1998), Craig and others (1985), Pessel and others (1978), Tailleur and others (1978a, b), Tailleur and Engwicht (1978)
C. Sherwood and others (1998)
D. Contours by Ken Bird
E. Grantz and others (2002, plate 1)
F. Topography
G. Grantz and others (1990, figure 4)
H. Jackson and Oakey (1990, plate 5)

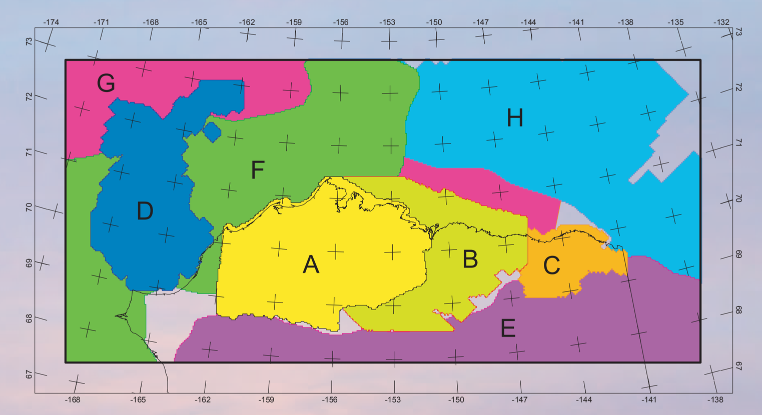


Topography/bathymetry

from the International Bathymetric Chart of the Arctic Ocean, beta version

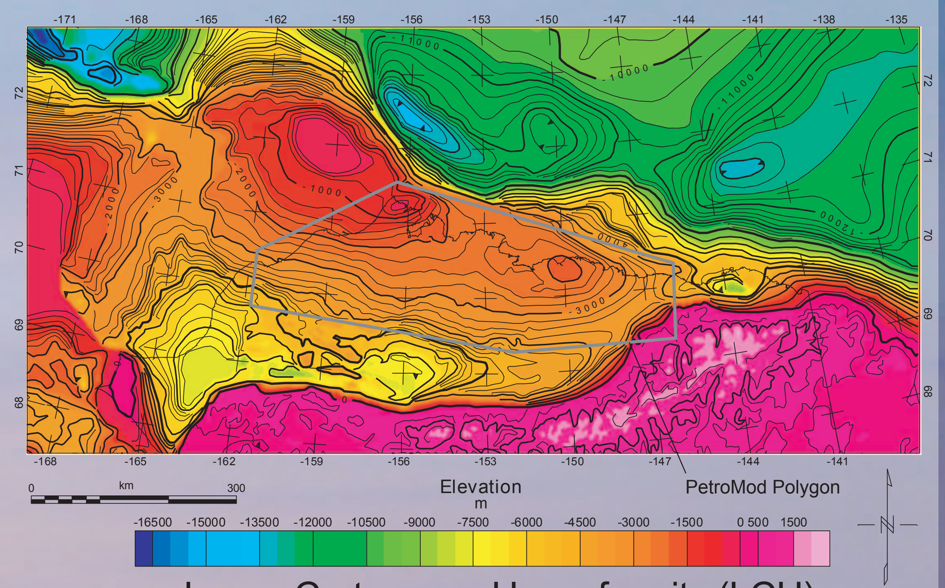


Shublik

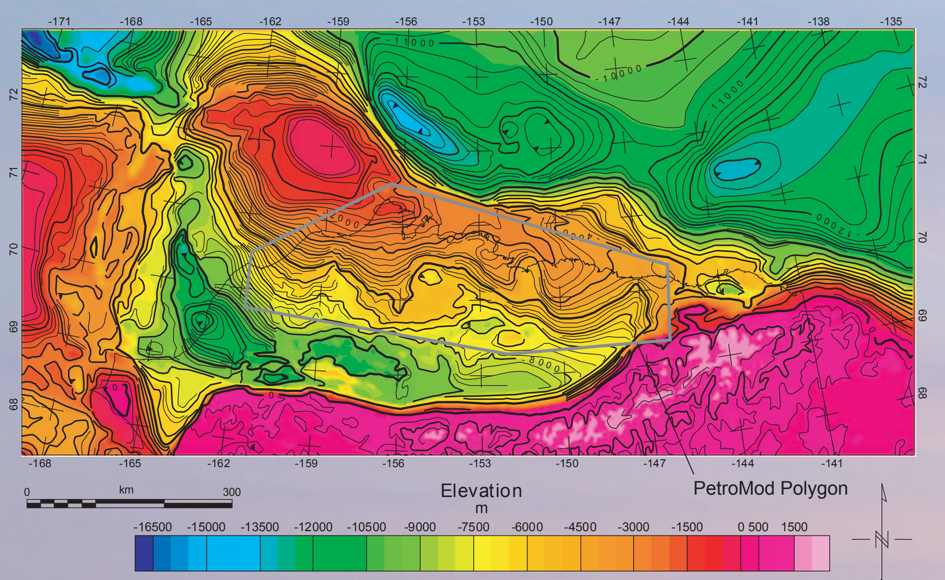


Basement data index map

A. Bruynzeel and others (1982) modified by Saltus and others (2002)
B. Pessel and others (1978), Tailleur and others (1978a, b), Tailleur and Engwicht (1978)
C. ANWR Assessment Team (1998)
D. Sherwood and others (1998)
E. Topography
F. Grantz and others (2002, plate 1)
G. Grantz and others (1990, figure 4)
H. Jackson and Oakey (1990, plate 5)



Lower Cretaceous Unconformity (LCU)



Seismic Basement

Discussion

Evaluation of undiscovered oil and gas resources may certainly be accomplished in a piecemeal, sub-regional basis, but evaluation of an entire basin without regard to political boundaries is a more scientifically satisfying way to do it. The ANWR 1002 area, NPRA, and state lands portions of the Alaskan North Slope and the (federal) offshore are all sub-regions that are being or have been separately evaluated. A region-wide approach with emphasis on petroleum systems as described in Magoon and Dow (1994) is the goal here. Modern, computer-based resource assessment allows the digitization, assembly, editing, and interpretation of three-dimensional geologic information. The four depth horizons assembled for this report provide a basic framework for modeling of regional fluid flow and, in areas of sufficient data density, for estimation of area and volume of possible trapping structures.

Although the four depth horizon grids presented here have been defined over the entire study area, the mapping accuracy is not uniform throughout the area. Seismically determined depths are generally accurate to approximately ±10% assuming that the correct seismic interface is identified on the seismic section. We expect that within the Chukchi, NPRA, and ANWR portions of these data compilations that the mapped depths are broadly within ±10% of the actual depths. Horizon depths within the central state lands region have been estimated from extrapolation with limited well depth control and are probably less accurate in detail, perhaps ±15%. The Grantz and Arctic data regions are based on very sparse seismic data coverage and are certainly the least accurately mapped portions of these compilations.

All three subsurface depth horizons clearly reflect the prominent Barrow arch and adjacent deep Colville basin. To the south the Colville basin is overthrust by the Brooks Range. To the southwest, the Colville basin terminates against the Herald arch and Chukchi platform. The Barrow arch terminates to the southeast so that a significant shallow sedimentary section is present off the end of the arch in the eastern state lands and in the northwestern ANWR 1002 area. To the north of the Barrow arch a thick accumulation of Brookian sediments overlies the basement of the continental shelf and, in the east, the great thickness is related to the Tertiary Mackenzie delta. These accumulations thin northward into the depths of the Canadian basin.

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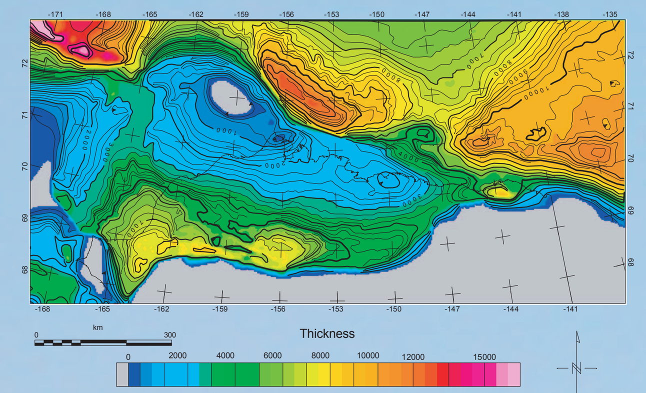
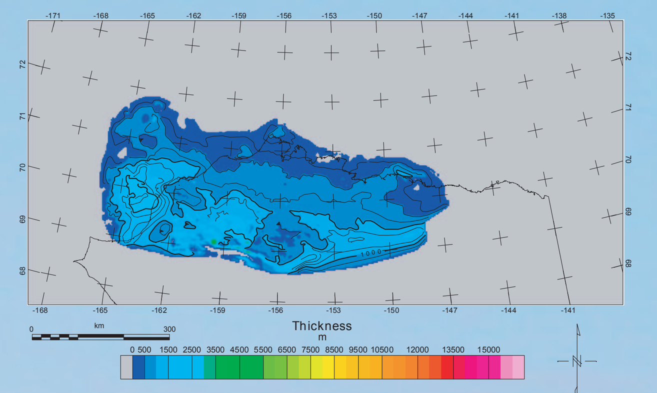
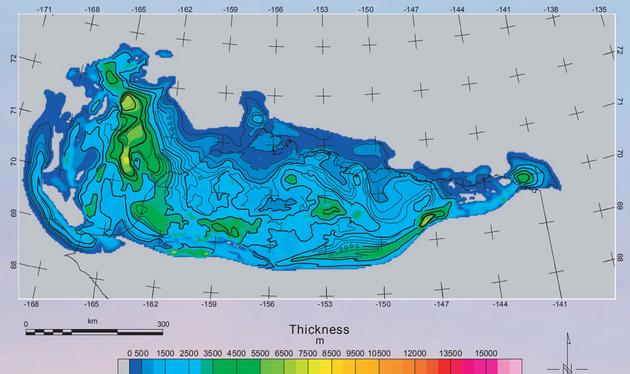


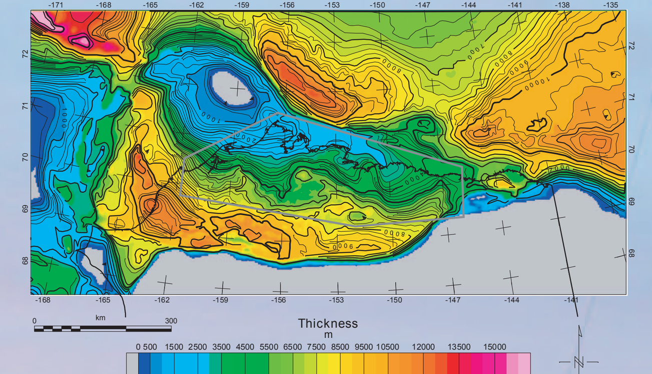
Brookian Interval



Beaufortian Interval



Ellesmerian Interval



Total Sediment Thickness

USGS Open-File digital data release may be found at:
http://pubs.usgs.gov/of/2003/ofr-03-230

This report is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards or with the North American Stratigraphic Code. Any use of trade, firm, or product names in this publication is for descriptive purposes only and does not imply endorsement by the U.S. Government.

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