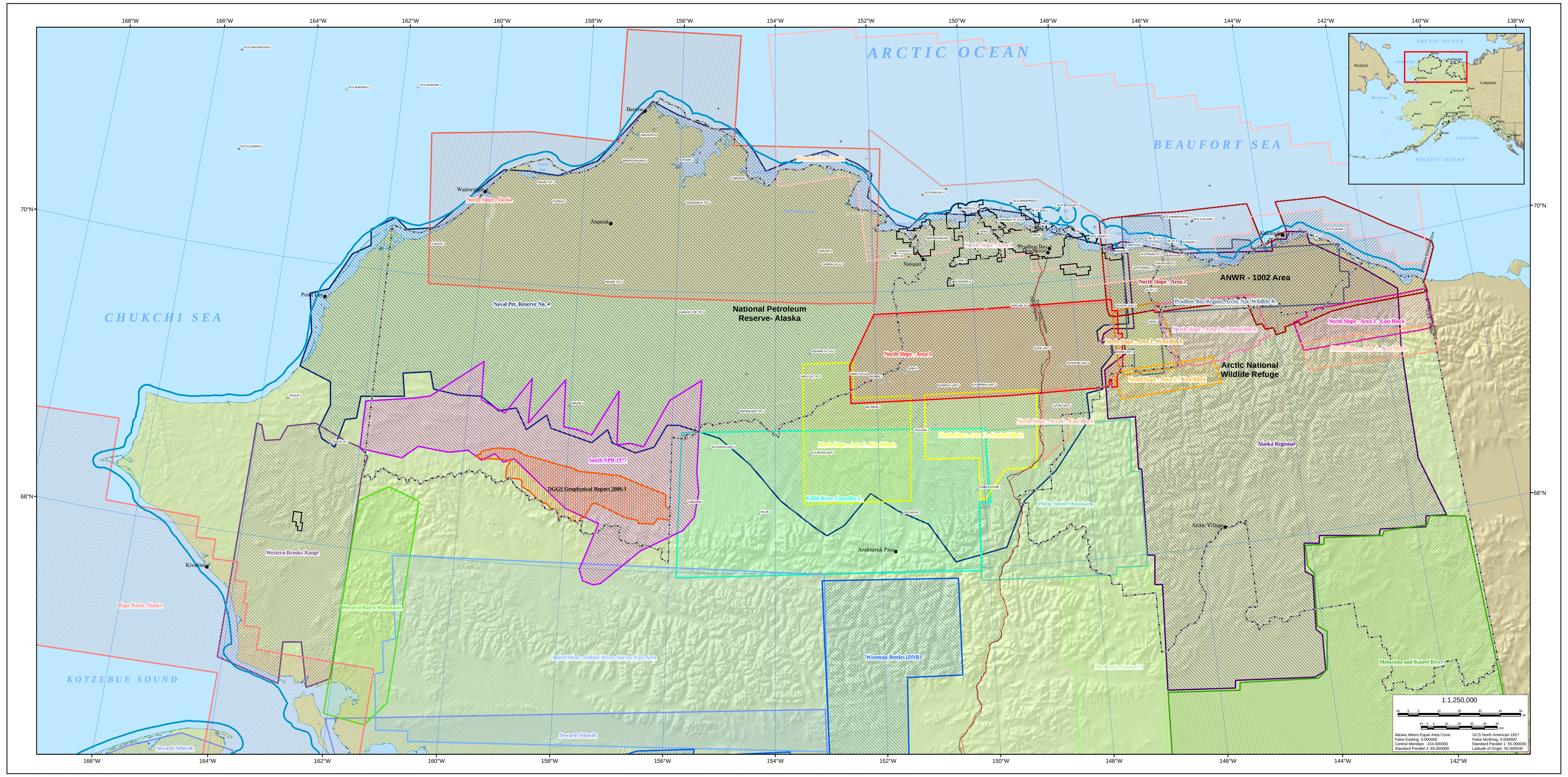
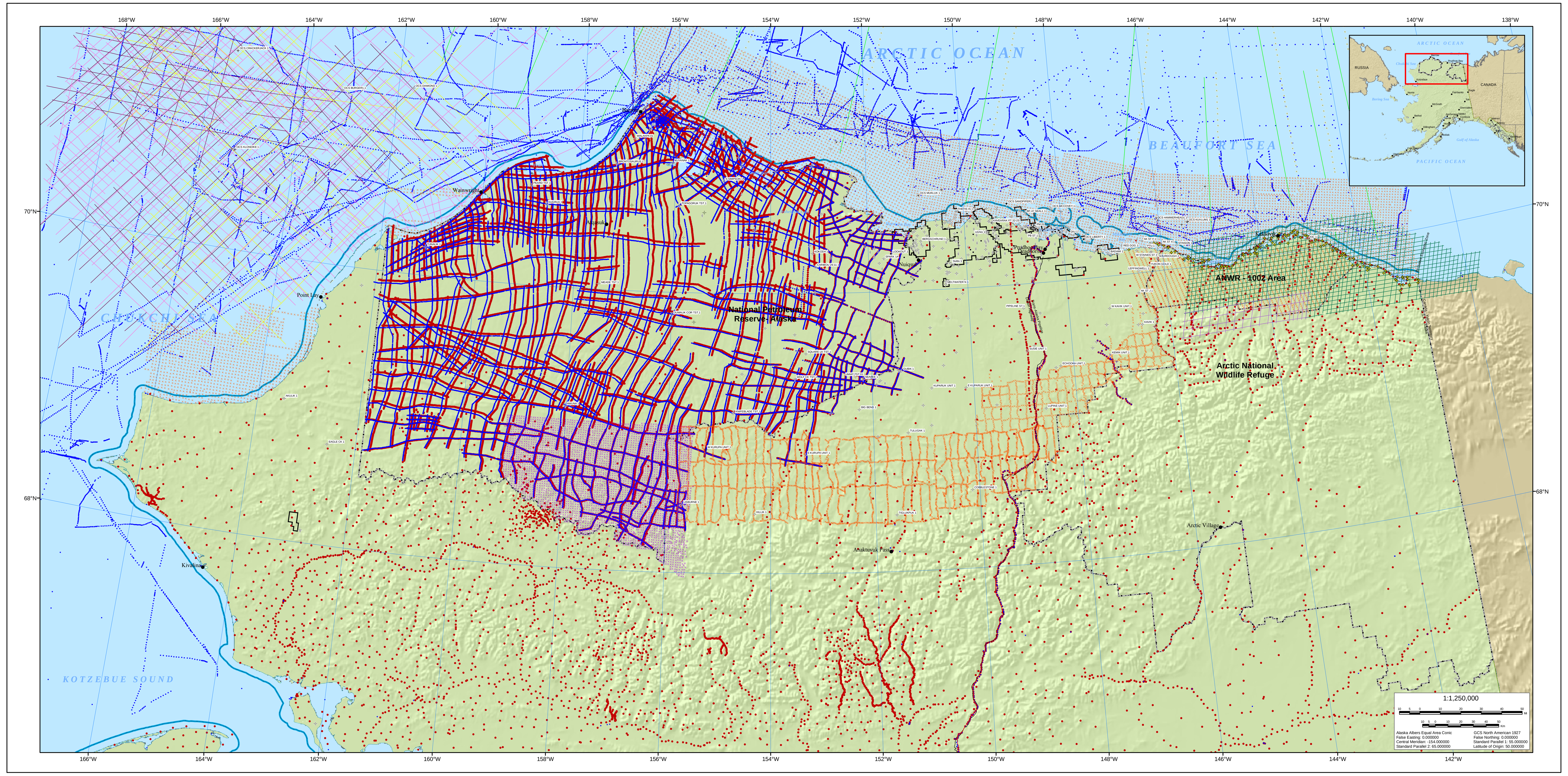
State of Alaska
Department of Natural Resources
Division of Oil and Gas

Gravity and Magnetic Data Availability for the North Slope of Alaska

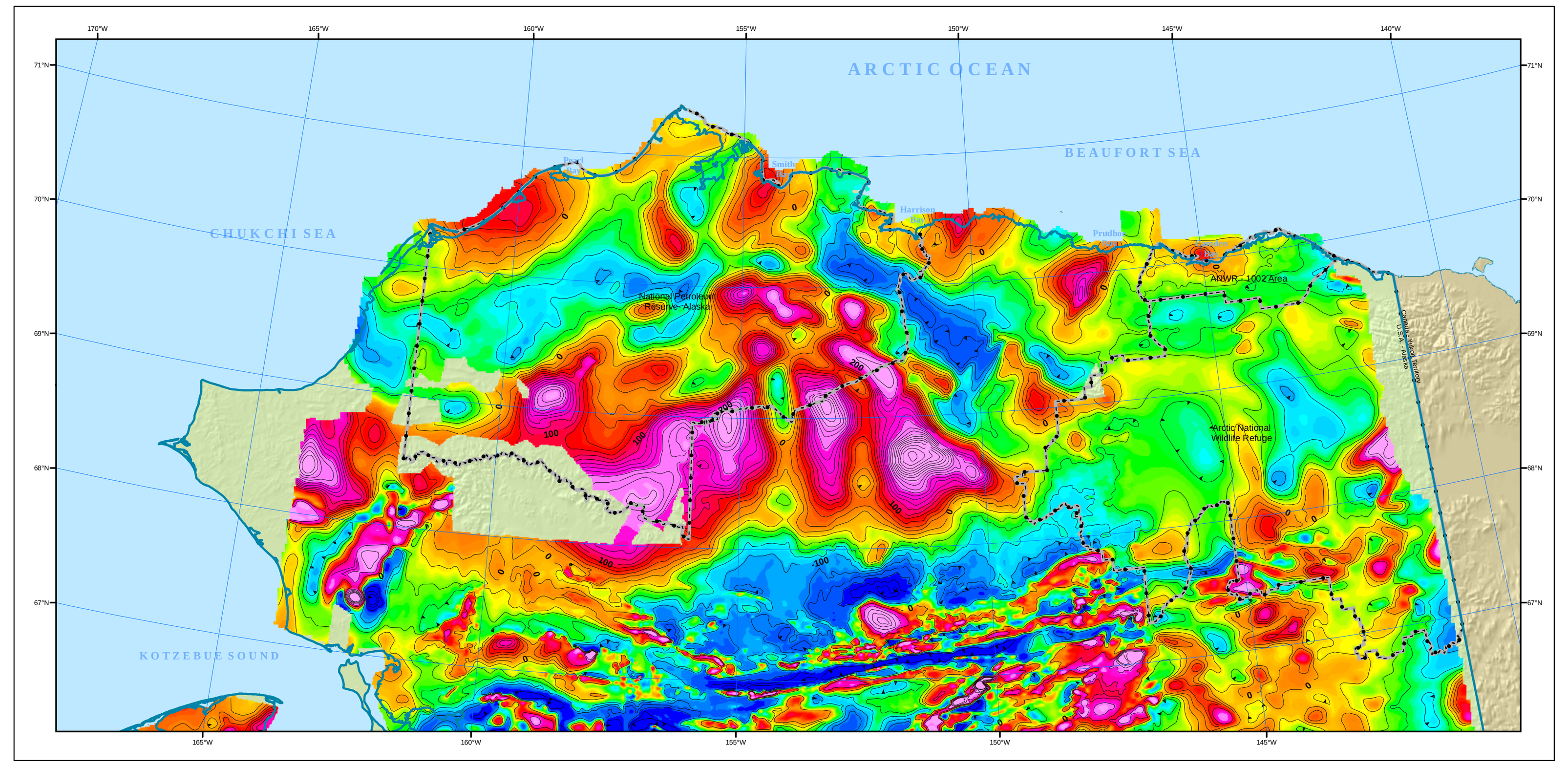
Publicly Available Magnetic Data



Publicly Available Gravity Data



Total Magnetic Field



1:2,700,000

Alaska Albers Equal Area Conic
False Easting: 0.000000
Central Meridian: -154.000000
Standard Parallel 2: 65.000000

GCS North American 1927
False Northing: 0.000000
Standard Parallel 1: 55.000000
Latitude of Origin: 50.000000

nT (nanoteslas)

-160 -120 -110 -90 -80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30 40 50 60 70 90 120 150 190 250

Map Published April 2008

MAGNETIC DATA EXPLANATION

Symbol	Magnetic Dataset	Dates Flown	Spacing	Altitude	Square Miles
Aeromagnetic Data Available from Alaska DGGS					
	Geophysical Report 2006-1	2005	0.25 – 0.125 mi.	100' Above Ground	1525
Aeromagnetic Data Available from FUGRO					
	Beaufort Sea, Alaska	1977	2 mi	1500' Barometric	14760
	Hope Basin, Alaska	1983	2 mi	1000' Barometric	11046
	North Slope, Alaska	1970	2 mi	1500' Barometric	10969
	North Slope - Area 1	1991	0.5 mi	500' Above Ground	13420
	North Slope - Area 2	1991	0.5 mi	1000' Above Ground	31817
	North Slope - Area 3 - West Block	1991	0.5 mi	500' Above Ground	1662
	North Slope - Area 3 - Central Block	1991	0.5 mi	6000' Above Ground	3156
	North Slope - Area 3 - East Block	1991	0.5 mi	6000' Above Ground	2794
	North Slope - Area 4	1992	0.5 mi	500' Above Ground	17627
	North Slope - Area 5 - West Block	1991	0.5 mi	8000' Above Ground	1913
	North Slope - Area 5 - East Block	1991	0.5 mi	8000' Above Ground	2016
	North Slope - Area 7 - Central Block	1992	0.5 mi	500' Above Ground	4734
	North Slope - Area 7 - East Block	1992	0.5 mi	500' Above Ground	805
	North Slope - Area 7 - West Block	1992	0.5 mi	500' Above Ground	7468
Aeromagnetic Data Available from USGS					
	Naval Pet. Reserve No. 4	7/45-8/46	2-4 mi.	1000' Above Ground	51213
	Alaska Regional	7/1/1965	10 mi.	5000' Barometric	24541
	Northeast Alaska '73	8/73-9/73	1 mi.	1000' Above Ground	15316
	Philip Smith Mountains	10/76-11/76	1 mi.	1000' Above Ground	5607
	Killik River-Chandler L.	6/1/1982	2 mi.	4000' Barometric	10486
	Seward-Selawik	6/75-7/75	6 mi.	400' Above Ground	25129
	Melozitna and Kateel River	5/76-8/76	6 mi.	400' Above Ground	15734
	Western Brooks Range	1958	6.5 mi.	5000' Barometric	6422
	Western Baird Mountains	1970	varies	5000' Barometric	3254
	Baird Mtns.-Ambler River, Survey Pass Area	73-75	0.75-1 mi.	1000' Above Ground	19052
	Wiseman-Bettles (DNR)	1978	0.75 mi.	1000' Above Ground	8425
	Prudhoe Bay Region, Arctic Nat. Wildlife R.	1981	1-3 mi.	300' Above Ground	4134
	South NPR 1977	1977	6-10 mi.	800' Above Ground	7205

DATA SOURCES FOR MAGNETIC DATA

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http://pubs.usgs.gov/of/1997/ofr-97-0520/

GRAVITY AND MAGNETIC DATA DISCUSSION

Gravity and magnetic data, collectively referred to as potential fields data, have been collected in Alaska for over 50 years and are available from a number of sources. Despite this long history and extensive acquisition efforts, data coverage across the state is still incomplete and efforts are continually under way to fill in the holes. However, the existing network of gravity and magnetic data is sufficient to define regional anomalies and allows for high-resolution interpretations along major transportation corridors and in areas that have been heavily explored for energy and minerals resources.

The use of gravity and magnetic anomalies can provide a fundamental understanding of the earth's structure and dynamics and is useful in understanding the geologic structure of an area. The use of data reduction and modeling tools can also be applied to these data to allow for the many different surveys to be combined into a consistent dataset. Use of this data can assist in the mapping of mafic and ultramafic rock units that may be important to mineral exploration as well as help in the delineation of basins that may be prospective for hydrocarbons. Various gravity and magnetic anomalies, trends, and features can be useful in understanding the tectonic structure of a region, including the delineation of major faults.

By processing raw gravity measurements, many anomalies can be identified that relate to important geological features. The processing steps commonly applied to gravity data are the latitude correction, elevation (free air and simple Bouguer) corrections, and terrain (complete Bouguer) correction. The latitude correction accounts for variation in the gravitational field due to the rotation of the earth and the fact that the earth is not a perfect sphere. The free air correction accounts for the variation in gravity due to distance from the center of the gravitational field; it corrects each reading to a common reference elevation datum (usually sea level), equidistant from the center of the earth. The simple Bouguer correction removes the gravitational effect of the excess mass present between the station elevation and the reference plane, and is performed at each station as if the excess mass were distributed as a uniform slab of infinite extent. Finally, terrain or complete Bouguer corrections use digital elevation models to account for the actual spatial distribution of this excess mass. It is important that all of these corrections be applied in the same way to all of the data sets that are being merged.

Once these corrections are applied, the resulting gravity anomalies can be used to help define the local geologic structure. In particular, regions with relatively low gravity values will typically indicate areas that contain sedimentary basins or upper-crustal igneous intrusions. Regions of relatively high gravity values commonly contain dense mafic units or ultramafic complexes in the upper crust. Geologic features of local or exploration interest are normally best defined on first residual anomaly maps, generated by removing the effects of deep, long-wavelength, regional gravity variations attributable to fluctuations in overall crustal density or thickness.

Magnetic data can be used either in stand alone interpretations or in conjunction with gravity data to understand an area's geology and structure. As with gravity data, the ideal processing flow chosen depends on the subject under investigation. In general, the earth has a dipolar magnetic field that originates in the core. In Alaska, this magnetic field dips steeply and has a magnitude of between 50,000 and 60,000 nanoteslas. When magnetic data are collected in the field, the measured reading includes both the value of the earth's global magnetic field and local distortions of the field caused by magnetic minerals in rocks at a given station. Magnetic susceptibility is the property that determines how much induced magnetic anomaly a body of rock produces. In general, sedimentary rocks and most metamorphic rocks have relatively low magnetic susceptibility, whereas igneous rocks tend to be more magnetic, with more mafic rocks having the highest susceptibility.

The total magnetic anomaly contains the effects of features from a wide range of depths. A common technique used to distinguish between deep versus shallow sources is called upward continuation, which adjusts the measured magnetic readings to what they would be if collected at a different datum elevation. Using this technique, shallow sources dominate the magnetic anomalies at lower datum elevations, whereas more regional sources dominate at higher datum elevations.

This publication was compiled for the purpose of documenting the extent and availability of gravity and magnetic data throughout the state. Much of the data is available publicly from the sources listed, although surveys have also been collected by private agencies and are available for purchase. The majority of the publicly available potential field data for Alaska has been collected and compiled by David F. Barnes, Robert L. Morin and Richard W. Saltus of the USGS, and John F. Meyer of the Division of Oil and Gas. A new compilation of the gravity data within the State by Richard W. Saltus, Philip J. Brown, Robert L. Morin and Patricia L. Hill of the USGS is currently in preparation.

MAP SYMBOLS

Exploration Wells

- Drill Hole
- Oil Well
- Gas Well
- Service Well (Un-differentiated)
- Suspended
- Suspended - Oil Show
- Plugged & Abandoned
- Plugged & Abandoned - Oil Show
- Plugged & Abandoned - Gas Show
- Plugged & Abandoned - Oil and Gas Show
- Plugged & Abandoned - Oil (Certified or Significant)
- Shut-in Location
- Operational Shutdown
- Permitted Location

Map Features

- Trans Alaska Pipeline
- 3-Mile Limit
- Unit Boundaries

POINTS OF CONTACT

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GIS DATA SOURCES

Base map data, including hydrologic data, village and town locations, land status and boundaries, hillshade and land cover, are adapted from the State of Alaska Statewide Core GIS database. Oil and gas wells are from the Alaska Division of Oil and Gas database as adapted from the Alaska Oil and Gas Conservation Commission dataset. The Total Magnetic Field values were adapted from publication (Burns, 2006). The Complete Bouguer Anomaly values were compiled from the Division of Oil and Gas gravity database. The Oil and Gas Units and Accumulations are based on multiple public sources and were compiled by the Division of Oil and Gas. Digital locations for Publicly Available Gravity and Magnetic Data were collected from public sources including the National Geophysical Data Center, the United States Geological Survey and the Alaska Division of Geological and Geophysical Surveys. Commercially available gravity and magnetic data locations were requested from the geophysical community.

REFERENCES CITED

Burns, L.E., U.S. Bureau of Land Management, Fugro Airborne Surveys, and Stevens Exploration Management Corp., 2006, Line, grid, and vector data and plot files for the airborne geophysical survey data of parts of the southern National Petroleum Reserve, Alaska, Northwest Alaska, GPR 2006-1, 3 disks.

Saltus, R.W., Connard, C.G., and Hill, P.L., US Department of the Interior, US Geological Survey, Alaska Aeromagnetic Compilation - Digital Grids and Survey Data, Open-File Report 99-502, 1999.

DISCLAIMER

This map was created, edited, and published by the State of Alaska, Department of Natural Resources, Division of Oil and Gas, and is for informational purposes only. Discrepancies in boundary alignments are the result of merging multiple data sets from a number of different sources.

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GRAVITY DATA EXPLANATION

Symbol	Survey Name	Location	# of Data Points
Gravity Data Available from Carson Services			
	Carson Survey 1	ANWR	unknown
	Carson Survey 2	ANWR	unknown
Gravity Data Available from EDCON			
	Chukchi Sea Barrow Arch 1985	Chukchi Sea/Arctic Ocean	unknown
	Chukchi Sea 1982-1985	Chukchi Sea/Arctic Ocean	unknown
	Chukchi Sea 1984	Chukchi Sea/Arctic Ocean	unknown
	North Chukchi Sea Ice	Arctic Ocean	517
+	Beaufort Sea Coastal Survey	Beaufort Sea Coast	123
x	Beaufort Sea Ice	Beaufort Sea/Arctic Ocean	375
x	Southern NPRA	Southern NPRA	3626
Gravity Data Available from PhotoGravity			
x	Photo Gravity	Several Locations	17,583
Gravity Data Available from the Department of Defense			
	Compilation of Surveys	North Slope	74,436
Gravity Data Available from USGS			
	Compilation of Surveys	North Slope	83,703
Note			
	Some data is available from both the DOD and the USGS. This is especially true in NPRA. Although these data are spatially identical, processing parameters could vary.		

DATA SOURCES FOR GRAVITY DATA

Carson Services Inc.
Aerogravity Division
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Chief Geophysicist
952 Blooming Glen Road
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Phone: 215-249-3535 Fax: 215-249-0726
bill.gumert@carsonservices.com
http://www.aerogravity.com/

Photo Gravity Corporation
Bob Gardner or George Parker
Houston Texas 77043
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http://www.photogravity.com/

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http://wrgis.wr.usgs.gov/docs/gump/morin/alaska/

National Geophysical Data Center (NGDC)
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http://gcmd.nasa.gov/records/GCMD_FE00116.html

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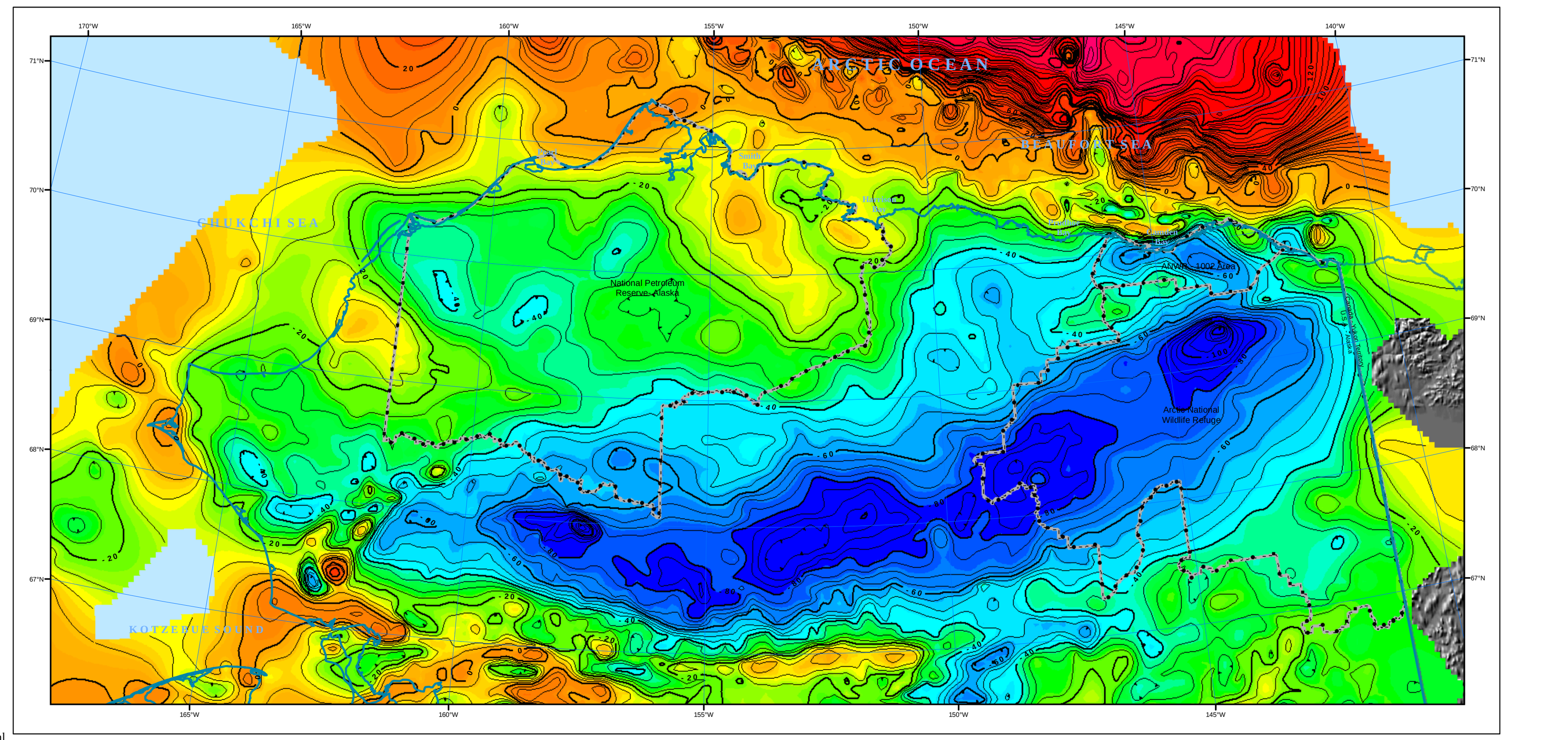
Complete Bouguer Gravitational Anomaly



mGal (milligals)

-80 -72 -62 -54 -50 -44 -40 -38 -34 -32 -30 -28 -26 -24 -20 -18 -16 -14 -12 -10 -8 -6 -4 -2 0 2 6 14 24 46 86 122 168 202 220 228 238 252

1:1,250,000

Alaska Albers Equal Area Conic
False Easting: 0.000000
Central Meridian: -154.000000
Standard Parallel 2: 65.000000

GCS North American 1927
False Northing: 0.000000
Standard Parallel 1: 55.000000
Latitude of Origin: 50.000000