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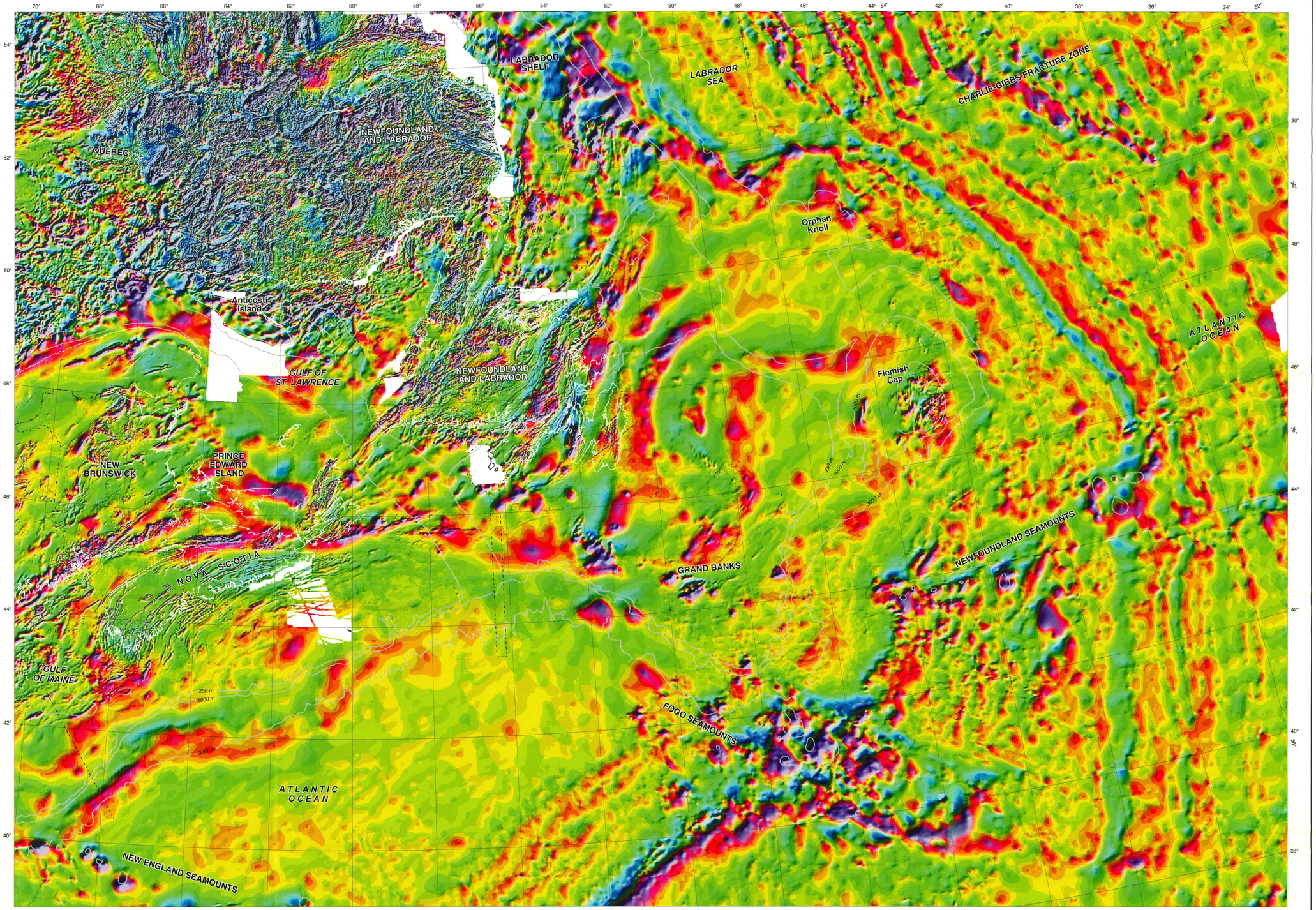

Atlantic Canada Magnetic Map Series

This series of shadow-enhanced magnetic anomaly maps of Atlantic Canada is based on a new 500 m grid assembled from marine track-data, modern digital airborne surveys, digitized profiles from contoured airborne surveys, and gridded data sets. New techniques for micro-levelling individual surveys were employed to image small-amplitude structures and provide offshore continuity of onshore geology. Regional levelling was achieved by adjusting the longer wavelength component (200 to 400 km) with high-elevation survey data. Wavelengths longer than 400 km are invariably due to sub-crustal sources and were removed from this data compilation.

The original data sources include coherent marine and aeromagnetic survey blocks and randomly-oriented marine tracklines. Individual survey blocks were micro-levelled using a Fourier-domain directional filter to remove cross-track Nyquist frequencies (Oakey et al., 1994). This technique involved gridding the raw data using a weighted minimum-curvature algorithm (Smith and Wessel, 1990) to a resolution finer than the track-spacing, applying the directional filter, and producing along-line corrections for the survey lines. For this application, high-amplitude anomalies (outside 2-sigma) were clipped to minimize contamination of correction values for adjacent areas.

In order to assemble the regional grid, the individual micro-levelled survey blocks were gridded at two resolutions (500m and 2km). The 500m grid blocks were high-pass filtered (2km) and a mosaic was assembled by smoothing the seams with a 2.5km weighted-mean filter. The 2km grid blocks were band-pass filtered (20 to 200 km) and a mosaic was assembled by smoothing the seams with a 10km weighted-mean filter. For most of the deep-water marine data, the tracklines of survey blocks were widely spaced (e.g. Scotian Slope) or data existed only as random tracks. In these areas, selected short sections of random lines were carefully merged with levelled survey blocks and merged with the band-passed 2km grid. Where data were very sparse (e.g. north-east of Sable Island) the tracklines are shown without interpolation. The high-elevation data (Haines and Hannaford, 1980) were gridded at a 20 km resolution, downward continued 4.2 km to correct anomaly amplitudes, and band-pass filtered (200 to 400km). This regional component and the band-passed 2 km grid were re-sampled at 500m resolution and added to the high-pass 500m grid to produce the final composite grid.

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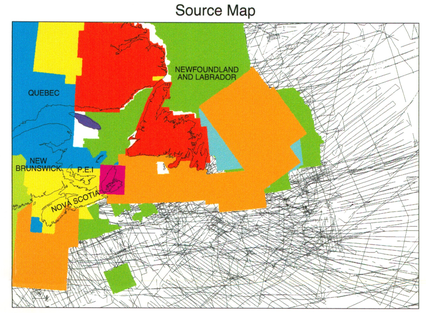
1990: Gridding with continuous curvature splines in tension. Geophysics, v.55, pp.293-305.

Source Map



1) Modern digital aeromagnetic data
2) Digital profiles from contour maps
3) Atlantic Canada 200m grid
4) Canada 1km grid
5) Hibernia .02°x.02° grid
6) Maine 1km grid
7) Cape Breton 250m grid
8) Shipborne survey blocks
9) Anticosti Island 5km grid
10) Regional shipborne tracklines

Data Sources:

1, 2, 4, 9: Geological Survey of Canada, Geophysical Data Centre, Ottawa, ON.

3: Unpublished data compilation by Paterson, Grant and Watson Limited, for B.D.L. Loncarevic, GSC, 1993.

5: Unpublished data compilation by K.G. Shih, GSC (Atlantic) (pers. comm. 1994).

6: Data compilation provided by D.L. Daniels, U.S. Geological Survey (pers. comm. 2002).

7: Dehler, S.A., and J. Verhoef (comp.) Magnetic Anomaly Map, Cape Breton Island, Nova Scotia, with Geology Overlay. Scale 1:250 000. Geological Survey of Canada, Open File 3378, 1996.

8, 10: Geological Survey of Canada (Atlantic), Dartmouth, NS.

Magnetic Anomaly Map: Atlantic Canada Region

The onshore-offshore area of Atlantic Canada encompasses the Proterozoic Grenville Orogen, the Paleozoic Appalachian Orogen, a rifted continental margin with associated Mesozoic/Cenozoic sedimentary basins and a transition from continental to oceanic crust. The magnetic signatures of the various tectonic zones are highly variable, and the following brief description is based on several recent geophysical reviews (Hayward et al., 2001; Williams et al., 1999; Woodside and Verhoef, 1989; Miller, 1995; Keen et al., 1990).

The Grenville Orogen, exposed in southern Quebec and Labrador, is characterised by a complex patchwork of high-amplitude, short-wavelength magnetic anomalies, reflecting both structural complexities and compositional variations. The Grenville Orogen extends seaward beneath the Gulf of St. Lawrence, and the frequency content of the magnetic anomalies gradually decreases due to an increase in depth to source burial beneath successively thicker early Paleozoic sedimentary rocks.

The magnetic anomalies of the Appalachian Orogen, exposed on the islands of Newfoundland and Cape Breton, and the mainland of Nova Scotia, New Brunswick, Quebec and Maine, are generally discrete, medium-amplitude features associated with a low-amplitude long-wavelength regional field. The boundaries between tectonic zones (Humber, Dunnage, Gander, Avalon and Meguma) are generally identified by marked contrasts in magnetic signatures. Over Newfoundland, most of the high amplitude anomalies correspond with ultramafic intrusions, while in southern Cape Breton, northern mainland Nova Scotia, and southern New Brunswick, high amplitude anomalies correspond with volcanic extrusive rocks. Over central New Brunswick, a thick cover of late Paleozoic sedimentary rocks subdues much of the magnetic signature. The magnetic anomalies over southern Nova Scotia reveal a complex pattern of tightly folded sedimentary rocks with a low amplitude central area caused by a large non-magnetic granitic pluton.

Along the Scotian Shelf, the continental basement rocks are deeply buried beneath sedimentary rocks of the Scotian Basin. Although the continent-ocean transition is not clearly defined by the magnetic anomalies, a linear positive anomaly near the 3000m bathymetric contour, (the East Coast Magnetic Anomaly or ECMA), correlates with seaward dipping reflectors interpreted as volcanic material extruded during initial rifting. On the Grand Banks, arcuate magnetic anomalies correlate with offshore extensions of the Appalachian terranes which are buried by sedimentary rocks of various basins, including the Orphan Basin and Jeanne d'Arc Basin. The high-frequency anomalies over Flemish Cap correlate with shallow basement of the Avalon zone beneath little or no sedimentary cover.

Magnetic anomalies over the oceanic crust feature the characteristic pattern of magnetic stripes that identify crust formed during normal and reverse periods of the Earth's magnetic field. In the Labrador Sea, this pattern is offset at the Charlie-Gibbs Fracture Zone, where oceanic crust of different ages is juxtaposed. Near the Grand Banks, the volcanic edifices of the Newfoundland and Fogo Seamounts are identified by positive magnetic anomalies. Seaward of the ECMA, the characteristic pattern of stripes is subdued, and correlates with the Jurassic Quiet Zone, a period of rapid polarity changes of the Earth's magnetic field.

References:

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1990: Tectonic and geophysical overview; Chapter 2 in Geology of the Continental Margin of Eastern Canada, M.J. Keen and G.L. Williams (ed.); Geological Survey of Canada, Geology of Canada, no. 2, pp.31-86. (also Geological Society of America, The Geology of North America, v. I-1).

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Cartographic production by Gary M. Grant, Electronic Publishing, Geological Survey of Canada (Atlantic)

OPEN FILE 1813

MAGNETIC ANOMALY MAP

ATLANTIC CANADA REGION

ATLANTIC CANADA

Scale 1:3 000 000/Échelle 1/3 000 000

Kilometres 50 0 50 100 150 200 250 Kilomètres

Transverse Mercator Projection
Central Meridian 60° West
North American Datum 1927
©Her Majesty the Queen in Right of Canada 2004

Projection de Mercator transverse
Meridien central 60° O
Système de référence géodésique nord-américain, 1927
©Sa Majesté la Reine du chef du Canada 2004

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1813
GEOLOGICAL SURVEY OF CANADA
COMMISSION GÉOLOGIQUE DU CANADA
2004

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Recommended citation:
Oakey, G.N., and Dehler, S.A.
2004: Magnetic anomaly map, Atlantic Canada region, Atlantic Canada. Geological Survey of Canada, Open File 1813, 1:3 000 000.

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