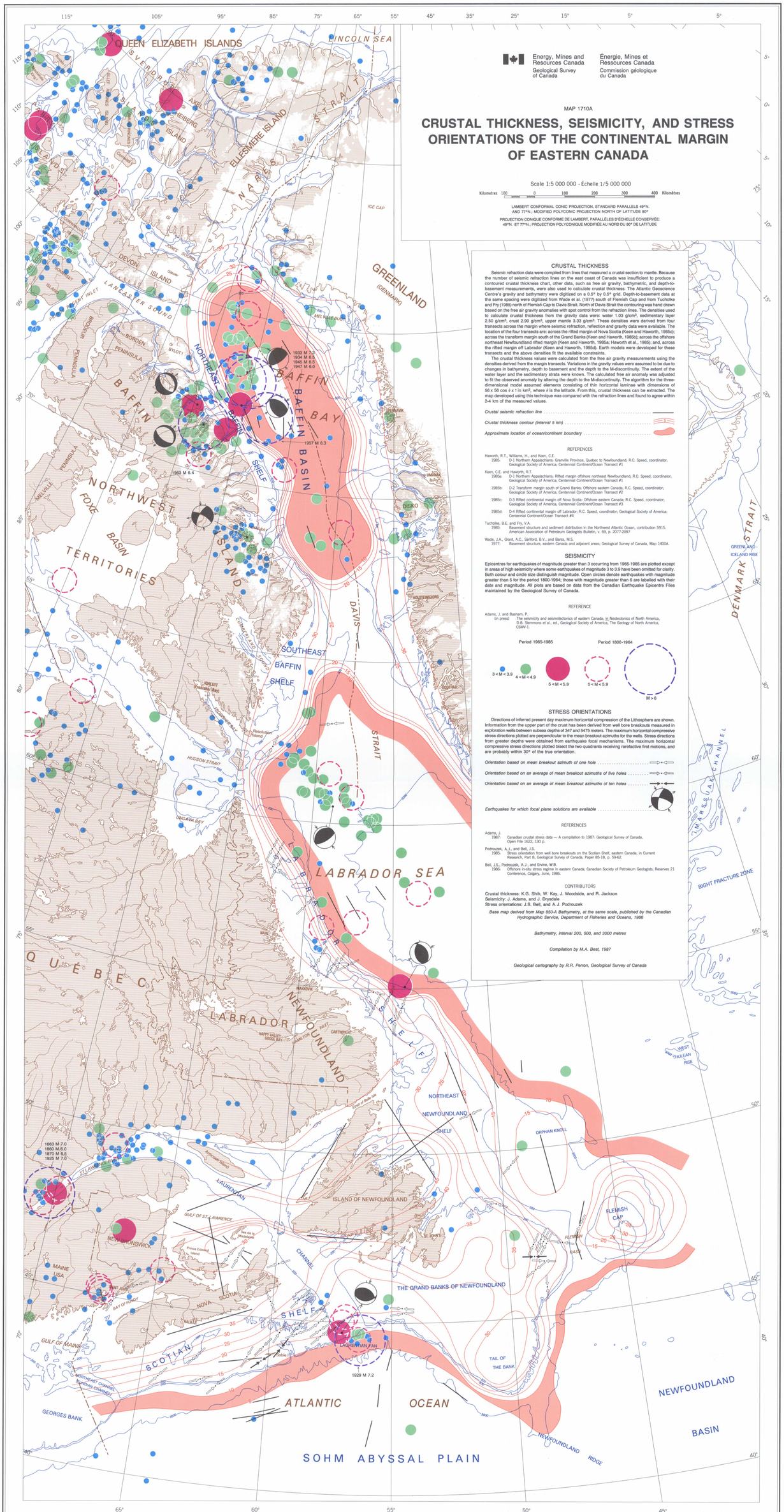

Energy, Mines and Resources Canada
Geological Survey of Canada

Énergie, Mines et Ressources Canada
Commission géologique du Canada

MAP 1710A

CRUSTAL THICKNESS, SEISMICITY, AND STRESS ORIENTATIONS OF THE CONTINENTAL MARGIN OF EASTERN CANADA

Scale 1:5 000 000 - Échelle 1/5 000 000

Kilometres 100 0 100 200 300 400 Kilometres

LAMBERT CONFORMAL CONIC PROJECTION, STANDARD PARALLELS 49°N. AND 77°N.; MODIFIED POLYCONIC PROJECTION NORTH OF LATITUDE 80°

PROJECTION CONIQUE CONFORME DE LAMBERT, PARALLÈLES D'ÉCHELLE CONSERVÉE: 49°N. ET 77°N.; PROJECTION POLYCONIQUE MODIFIÉE AU NORD DU 80° DE LATITUDE

CRUSTAL THICKNESS

Seismic refraction data were compiled from lines that measured a crustal section to mantle. Because the number of seismic refraction lines on the east coast of Canada was insufficient to produce a contoured crustal thickness chart, other data, such as free air gravity, bathymetric, and depth-to-basement measurements, were also used to calculate crustal thickness. The Atlantic Geoscience Centre's gravity and bathymetry were digitized on a 0.5° by 0.5° grid. Depth-to-basement data at the same spacing were digitized from Wade et al. (1977) south of Flemish Cap and from Tucholke and Fry (1985) north of Flemish Cap to Davis Strait. North of Davis Strait the contouring was hand drawn based on the free air gravity anomalies with spot control from the refraction lines. The densities used to calculate crustal thickness from the gravity data were: water 1.03 g/cm³, sedimentary layer 2.50 g/cm³, crust 2.90 g/cm³, upper mantle 3.33 g/cm³. These densities were derived from four transects across the margin where seismic refraction, reflection and gravity data were available. The location of the four transects are: across the rifted margin of Nova Scotia (Keen and Haworth, 1985c); across the transform margin south of the Grand Banks (Keen and Haworth, 1985b); across the offshore northeast Newfoundland rifted margin (Keen and Haworth, 1985a; Haworth et al., 1985); and, across the rifted margin off Labrador (Keen and Haworth, 1985d). Earth models were developed for these transects and the above densities fit the available constraints.

The crustal thickness values were calculated from the free air gravity measurements using the densities derived from the margin transects. Variations in the gravity values were assumed to be due to changes in bathymetry, depth to basement and the depth to the M-discontinuity. The extent of the water layer and the sedimentary strata were known. The calculated free air anomaly was adjusted to fit the observed anomaly by altering the depth to the M-discontinuity. The algorithm for the three-dimensional model assumed elements consisting of thin horizontal laminae with dimensions of $56 \times 56 \cos\phi \times 1$ in km³, where ϕ is the latitude. From this, crustal thickness can be extracted. The map developed using this technique was compared with the refraction lines and found to agree within 2-4 km of the measured values.

Crustal seismic refraction line .....

Crustal thickness contour (interval 5 km) .....

Approximate location of ocean/continent boundary .....

REFERENCES

Haworth, R.T., Williams, H., and Keen, C.E.
1985: D-1 Northern Appalachians: Grenville Province, Quebec to Newfoundland; R.C. Speed, coordinator; Geological Society of America; Centennial Continent/Ocean Transect #1

Keen, C.E. and Haworth, R.T.
1985a: D-1 Northern Appalachians: Rifted margin offshore northeast Newfoundland; R.C. Speed, coordinator; Geological Society of America; Centennial Continent/Ocean Transect #1

1985b: D-2 Transform margin south of Grand Banks: Offshore eastern Canada; R.C. Speed, coordinator; Geological Society of America; Centennial Continent/Ocean Transect #2

1985c: D-3 Rifted continental margin off Nova Scotia: Offshore eastern Canada; R.C. Speed, coordinator; Geological Society of America; Centennial Continent/Ocean Transect #3

1985d: D-4 Rifted continental margin off Labrador; R.C. Speed, coordinator; Geological Society of America; Centennial Continent/Ocean Transect #4

Tucholke, B.E. and Fry, V.A.
1985: Basement structure and sediment distribution in the Northwest Atlantic Ocean, contribution 5915. American Association of Petroleum Geologists Bulletin, v. 69, p. 2077-2097

Wade, J.A., Grant, A.C., Sanford, B.V., and Banks, M.S.
1977: Basement structure, eastern Canada and adjacent areas; Geological Survey of Canada, Map 1400A.

SEISMICITY

Epicentres for earthquakes of magnitude greater than 3 occurring from 1965-1985 are plotted except in areas of high seismicity where some earthquakes of magnitude 3 to 3.9 have been omitted for clarity. Both colour and circle size distinguish magnitude. Open circles denote earthquakes with magnitude greater than 5 for the period 1800-1964; those with magnitude greater than 6 are labelled with their date and magnitude. All plots are based on data from the Canadian Earthquake Epicentre Files maintained by the Geological Survey of Canada.

REFERENCE

Adams, J. and Basham, P.
(in press) The seismicity and seismotectonics of eastern Canada; in Neotectonics of North America, D.B. Slemmons et al., ed., Geological Society of America, The Geology of North America, CSMV-1.

Period 1965-1985 Period 1800-1964

3 < M < 3.9 4 < M < 4.9 5 < M < 5.9 5 < M < 5.9 M > 6

STRESS ORIENTATIONS

Directions of inferred present day maximum horizontal compression of the Lithosphere are shown. Information from the upper part of the crust has been derived from well bore breakouts measured in exploration wells between subsea depths of 347 and 5475 meters. The maximum horizontal compressive stress directions plotted are perpendicular to the mean breakout azimuths for the wells. Stress directions from greater depths were obtained from earthquake focal mechanisms. The maximum horizontal compressive stress directions plotted bisect the two quadrants receiving rarefactive first motions, and are probably within 30° of the true orientation.

Orientation based on mean breakout azimuth of one hole .....

Orientation based on an average of mean breakout azimuths of five holes .....

Orientation based on an average of mean breakout azimuths of ten holes .....

Earthquakes for which focal plane solutions are available .....

REFERENCES

Adams, J.
1987: Canadian crustal stress data — A compilation to 1987. Geological Survey of Canada, Open File 1622, 130 p.

Podrouzek, A.J., and Bell, J.S.
1985: Stress orientation from well bore breakouts on the Scotian Shelf, eastern Canada; in Current Research, Part B, Geological Survey of Canada, Paper 85-1B, p. 59-62.

Bell, J.S., Podrouzek, A.J., and Ervine, W.B.
1986: Offshore in-situ stress regime in eastern Canada; Canadian Society of Petroleum Geologists, Reserves 21 Conference, Calgary, June, 1986.

CONTRIBUTORS

Crustal thickness: K.G. Shih, W. Kay, J. Woodside, and R. Jackson
Seismicity: J. Adams, and J. Drysdale
Stress orientations: J.S. Bell, and A.J. Podrouzek

Base map derived from Map 850-A Bathymetry, at the same scale, published by the Canadian Hydrographic Service, Department of Fisheries and Oceans, 1986

Bathymetry, interval 200, 500, and 3000 metres

Compilation by M.A. Best, 1987

Geological cartography by R.R. Perron, Geological Survey of Canada

Copies of this map may be obtained from the Geological Survey of Canada 601 Booth Street, Ottawa, Ontario K1A 0E8 3303-33rd Street, N.W., Calgary, Alberta T2L 2A7

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