

MAGNETIC AND BOUGUER GRAVITY ANOMALY  
COMPILATIONS FOR THE APPALACHIANS

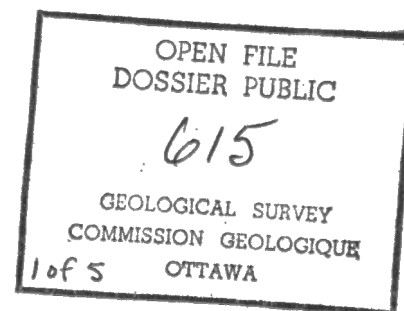
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## Introduction

The Bouguer Anomaly Map of Canada (1974) and the Magnetic Anomaly Map of Canada (McGrath et al, 1977) both at a scale of 1:5 million, and the Gravity Map of the United States (Woollard and Joesting, 1964) at a scale of 1:2.5 million are invaluable for deep structural interpretations in combination with the geological and tectonic maps of North America that are available at those same scales. With the initiation of Harold Williams' (Memorial University, St. John's, Newfoundland) work on a Tectonic Lithofacies synthesis for the entire Appalachian Orogen at a scale of 1:1 million (Williams, 1978a), the informal compilations maintained by Richard Haworth of both published and unpublished gravity and magnetic data for the Canadian (and Canadian offshore) Appalachians at that same scale began to acquire a wider significance and interest. It was agreed in the Spring of 1978 that it was timely for work to begin on compilation by Williams and Haworth, together with Isidore Zietz and David Daniels of the U.S. Geological Survey, of a gravity and magnetic map of the entire Appalachians to be compatible with Williams' map which was then in press. At that time, a preprint of Williams' synthesis at a smaller scale with somewhat generalized detail became available (Williams, 1978b). As visible indication of the benefits to be derived from the 1:1 million geophysical compilation, Haworth prepared compilations of published and his own unpublished data at a similar scale to Williams' (1978b) preprint map. These small scale compilations were prepared for slides to illustrate only broad regional interpretations and comparisons, rather than as a means of data exchange. However, many requests for copies were received pending completion of the 1:1 million compilations. Those illustrative compilations have therefore been photographed and released in this Open File to render whatever assistance they can to Appalachian research in the interim. As of 1st March 1979, the 1:1 million compilation of magnetic and gravity data for the area of Williams'

(1978a) map has been completed. It is anticipated that those compilations will go to press during the summer of 1979 leading to a publication date late in 1979. At that time, this Open File will become redundant, except perhaps for the information it includes for those areas lying beyond the limits of Williams' (1978a) map, particularly northeast of Newfoundland and along the Atlantic continental margin (Figures 5 and 6).

These compilations were presented in August 1978 to the International Working Group Meeting of Project 27 "The Caledonide (Appalachian) Orogen" of the International Geological Correlation Programme. That group accepted in principle the necessity for assembling a working group to study the application of geophysical methods to Appalachian problems. Anyone interested in participating in the activities of such a group is invited to contact the author.

#### Data Content

Figures 5 and 6 provide a key to the data sources used in the gravity and magnetic compilations respectively.

Gravity: The Haworth unpublished compilation is an ongoing research compilation of the most up-to-date gravity data available to the author in the Canadian (and Canadian offshore) Appalachians. Portions of that compilation (as it was in mid 1978) had been formally published (Weaver 1968; Goodacre et al, 1969; Stephens and Cooper 1973; Haworth and MacIntyre 1975, 1977) and the basic data incorporated in a more generalized form in the Bouguer Anomaly Map of Canada (1974). Data for the United States were obtained from the Gravity Map of the United States (Woollard and Joesting, 1964) and converted from the "U.S. Gravity Network/1930 reference field" base used by Woollard and Joesting to that of the

"IGSN'71/1967 reference field" base used for the Canadian portion of the compilation by the application of a latitudinally dependent correction (IAG, 1967)

Magnetic: The Canadian portion of the compilation of magnetic data was initially a combination of data compiled and published by Haworth and MacIntyre (1975, 1977) with that compiled by Peter Hood (Geological Survey of Canada, Ottawa) from the results of the Canadian aeromagnetic survey program (McGrath et al, 1978) in preparation of the Magnetic Anomaly Map of Canada (McGrath et al, 1977). Part of that compilation was presented by Hood et al (1975), and later released in a more generalized form by Hood and Reveler (1977). The mid-1978 version of Haworth's unpublished compilation retained the detail of the Hood et al (1975) compilation and incorporated data collected in the interim on the continental margin northeast of Newfoundland. The Canadian data were tied to an absolute datum, and the IGRF'65 regional field (IAGA, 1969) removed. For the United States, the published maps of Taylor et al (1968) and Zietz et al (1977) were used. The data on their maps were referred to an arbitrary datum, but a regional field had been removed. The best fit across the U.S.-Canada border was obtained by removing a base of 800 nT from the Taylor et al (1968) data and 10800 nT from the Zietz et al (1977) data. The resultant combination is therefore a depiction overall with respect to IGRF'65.

#### Lineaments

In addition to the coast, state and provincial boundaries which are included on each figure to provide scale and geographic reference independent of the vagaries of the photographic reproduction processes, additional lineaments have been defined by the heavy lines (Figures 1 to 4). These lineaments, whose definitions are given below, are features of the geophysical field alone. It must be recognized that the geological cause of the long wavelength magnetic and gravity anomalies may well be at depth rather than being associated with

the rocks exposed at the surface. The significance of some of the lineaments is discussed with reference to the surface geology or to subsurface structure as inferred from seismic data, but in other cases their interpretation is completely conjectural. The linears presented here serve only as a stimulus for discussion, and to assist geographical intercomparison between the compilations. Many more linears are apparent, but a complete interpretation is not attempted here. That will be left for more thorough treatment following publication of the 1:1 million compilation.

Figure 7 provides a key to the lineaments overlaying figures 1 through 4, whose description now follows:

NAME (FIGURE 7)	HOW DEFINED: (G=GRAVITY) (M=MAGNETICS)	DESCRIPTION
AB	G	The eastward limit of gravity lows in the southern Appalachians, with the possible interpretation from analogous situations farther north that the Inner Piedmont west to the Brevard Zone is allochthonous.
CD	G(M)	The western edge of a zone of high gravity values trending into the area of low gravity, and the westward limit of high amplitude, short wavelength magnetic anomalies. Follows the northern section of the Brevard Zone.
DE	M?(G?)	A trend transverse to the main magnetic anomaly trend. The southern limit of a zone of low magnetic and gravity anomalies trending east-west in southern New Jersey, northern Delaware and Maryland. (? indicates lower reliability and significance).
DF	G	Northward continuation of BD as the eastern limit of low gravity values. Follows the major deflection in Appalachian structures around the New York Promontory.
FG	G	Northward continuation of the east-west increase in gravity seen along BF except that a gravity low appears on the eastern side. That low may be due to sedimentary and plutonic rocks lying between the Precambrian cratonic margins. or to the location of transported units on its eastern side (similar

NAME (FIGURE 7)	HOW DEFINED: (G=GRAVITY) (M=MAGNETICS)	DESCRIPTION
		to the area between C and AB)
GH	G	A continuation of the FG gravity trend except that the gravity field is depressed even more by the presence of transported rocks on the southern shore of the lower St. Lawrence, a possible analog of the situation along the Brevard Zone.
HI	GM	Follows the southern limit of low gravity values correlative with Grenville crust, and the zone of high magnetic values extending towards the location of magnetic highs correlative with the Gaspé ophiolites (see Haworth and MacIntyre, 1977).
IJ	G	At I the continuity of the gravity and magnetic lineation HI is disrupted by the over 12 kilometre thickness of Carboniferous sedimentary rocks in the southeastern Gulf of St. Lawrence. Within Newfoundland the southern limit of negative Bouguer gravity anomalies parallels the southeastern limit of Grenville crust.
QRTVX	M	The East Coast Magnetic Anomaly of Taylor et al (1968) following the edge of the continental margin, except at its southern end where it divides as shown by Taylor et al (1968) into two trends, one heading inland as shown here and the other continuing southward along the margin. There is a similarity between QRTVX and 1268 in that SR, UT and WV are tributaries to QRTVX as 32, 54, 76 and 98 are tributaries to 1268.
RS	MG	Magnetic and gravity highs which act as tributaries to the East Coast Magnetic Anomaly (see QRTVX). By analogy with 23, 45, 67 and 89 on the Grand Banks they may coincide with structural highs on the continental margin separating basins within the sedimentary province south of the Long Island to Cape Cod coast.
TU	MG	
VW	MG	
1268	MG	The magnetic Collector Anomaly (Haworth 1975) which acts as a collector for tributaries 23, 45, 67 and 89, and which has a gravity high associated with it. Appears to follow the boundary between the Avalon and Meguma zones (Haworth and Lefort, 1979). Note the divergence from the southern edge of the Grand Banks.

NAME (FIGURE 7)	HOW DEFINED: (G=GRAVITY) (M=MAGNETICS)	DESCRIPTION
23 45 67 89	M(G)	Magnetic highs associated with Precambrian volcanic "highs" ashore, and separated by magnetic lows correlated with metasedimentary filled "lows". This vertical tectonic pattern has been reactivated in the offshore areas where the basins include the Mesozoic sedimentary rocks drilled for oil prospects (note similarity to RS, TU and VW).

## FIGURES

Figure 1: (Colour print C of GSC Open File 615)

Generalized version (Williams 1978b) of the Tectonic Lithofacies map of the Appalachian Orogen (Williams 1978a). Approximate scale, 1:8 million.

Figure 2: (Colour print A of GSC Open File 615)

Bouguer gravity anomaly compilation for the Appalachian Orogen from data sources indicated in figure 5. Approximate scale, 1:8 million. Anomalies are referred to IGSN '71 and the 1967 reference field.

Figure 3: (Colour print B of GSC Open File 615)

Magnetic anomaly compilation for the Appalachian Orogen from data sources indicated in figure 6. Approximate scale, 1:8 million. Anomalies are referred to IGRF '65.

Figure 4: (Colour print D of GSC Open File 615)

Composite of figures 1,2 and 3. Approximate scale, 1:15 million.

Figure 5: Sources of gravity data

Figure 6: Sources of magnetic data

Figure 7: Geophysical lineaments described in text.



FIGURE 5: SOURCES OF GRAVITY DATA

- |                              |  |
|------------------------------|--|
| 1: Haworth (unpublished)     | 5: Haworth and MacIntyre, 1975         |
| 2: Weaver, 1968              | 6: Haworth and MacIntyre, 1977         |
| 3: Goodacre et al, 1969      | 7: Bouguer Anomaly Map of Canada, 1974 |
| 4: Stephens and Cooper, 1973 | 8: Woollard and Joesting, 1964         |

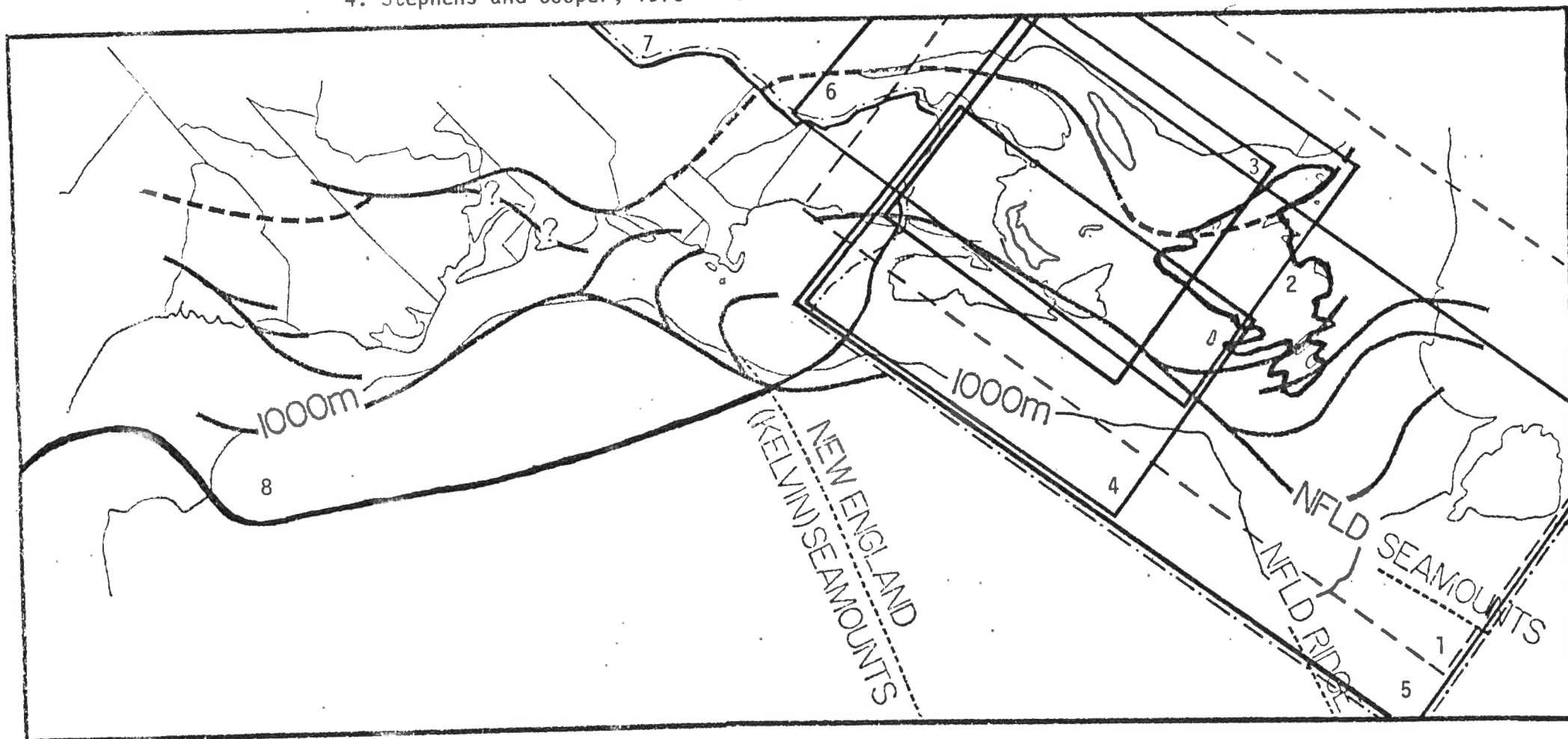


FIGURE 6: SOURCES OF MAGNETIC DATA

- |                                |                          |
|--------------------------------|--------------------------|
| 1: Haworth and MacIntyre, 1975 | 5: Haworth (unpublished) |
| 2: Haworth and MacIntyre, 1977 | 6: Taylor et al, 1968    |
| 3: Hood et al, 1975            | 7: Zietz et al, 1977     |
| 4: Hood and Reveler, 1977      |                          |

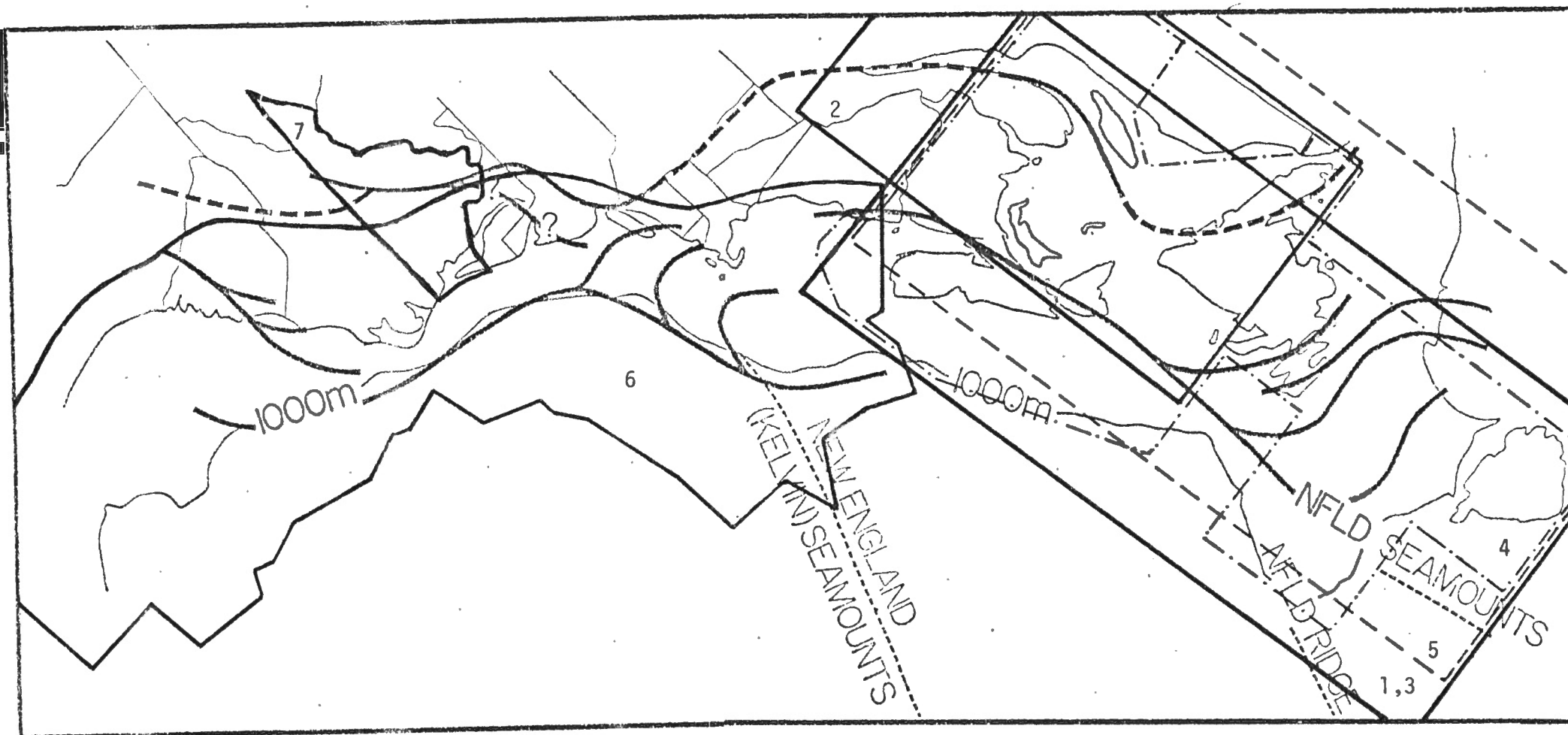
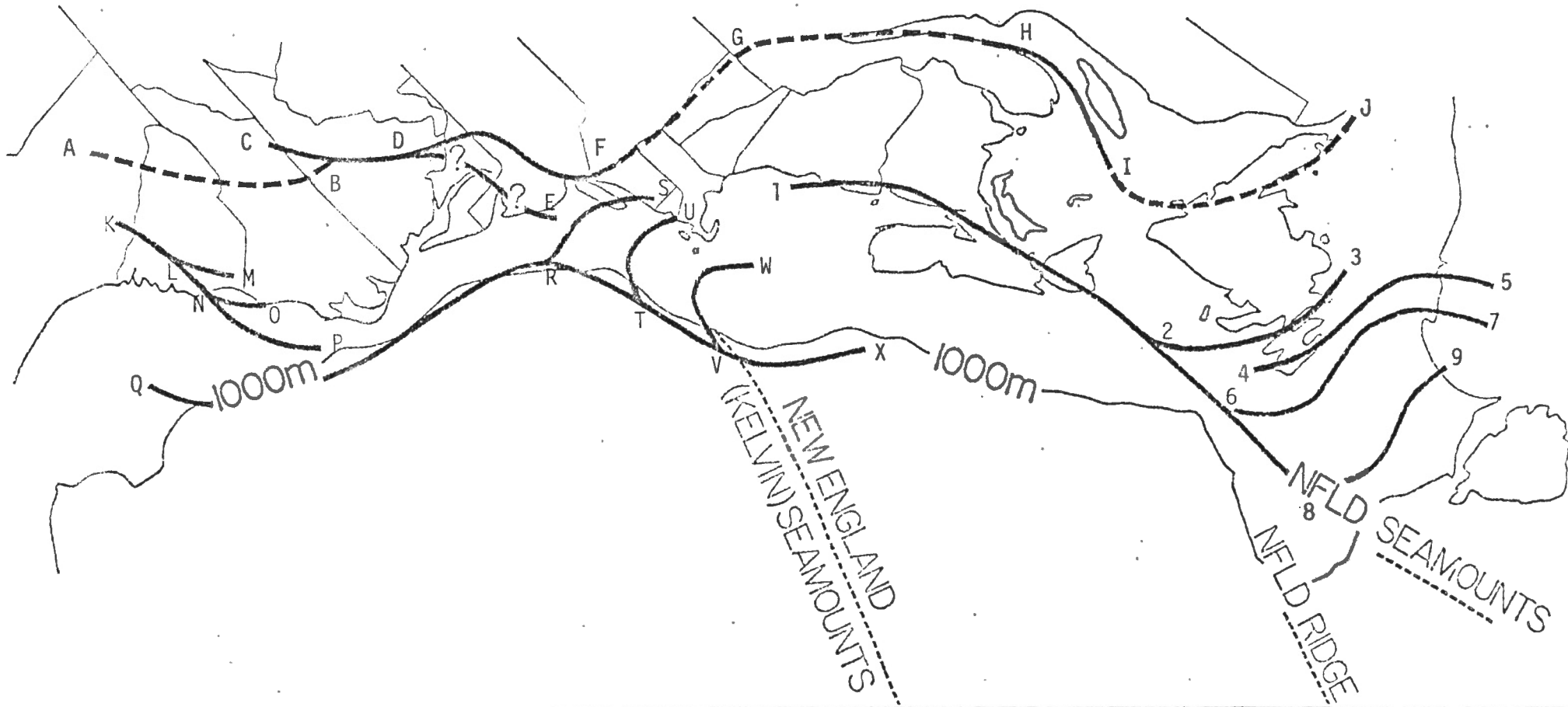


Figure 7: Geophysical Lineaments Described in Text



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