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NEWFOUNDLAND AEROMAGNETIC TOTAL-FIELD, GRADIOMETER AND VLF-EM SURVEY, 1986/87

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ABSTRACT

An aeromagnetic total-field, gradiometer and VLF survey was carried out over part of the Dunnage Zone in central Newfoundland. This part of the Dunnage Zone is geologically complex and well suited to aeromagnetic mapping. Aerodat Limited of Toronto carried out the contract in 1986–87 using a rotary wing aircraft.

Results from the survey are available at two map scales: 1:25,000 aeromagnetic total field and gradiometer contour maps, and 1:50,000 magnetic anomaly and gradiometer colour interval maps. The VLF-EM total field and quadrature profiles are printed on the back of the 1:50,000 maps.

The aeromagnetic results substantiate and expand upon the known geology in this part of the Dunnage Zone. In particular, the gradiometer colour maps show clearly defined intrusive features and major transcurrent faults. A series of folded sills, as well as a thrust sheet, can be identified in the middle and northern regions of the survey area.

INTRODUCTION

Under the Canada–Newfoundland Mineral Development Agreement, an aeromagnetic total-field, gradiometer and VLF-EM survey was carried out over an area within the Dunnage Zone of central Newfoundland. A sketch of the survey location is shown in Figure 1. The complexity of the basement in this area is such that its structural and compositional changes have a definite magnetic signature, making indirect geological mapping through aeromagnetics very successful.

The contract to carry out the field survey was awarded to Aerodat Limited of Toronto, and the survey was flown between November 1986 and August 1987, using a rotary wing aircraft. Two Cesium vapour magnetometers separated by 3 m, each with a resolution of 0.002 nanoteslas, measured the gradient field. VLF-EM total field and vertical quadrature components were recorded with a Herz Totem-2A receiver, using the Annapolis, Maryland transmitter signal. A mean elevation clearance of 150 m was maintained with a flight line separation of 300 m and a control line separation of 5 km.

Survey results are available at two map scales: 1:25,000 aeromagnetic total-field and gradiometer contour maps and 1:50,000 magnetic anomaly and gradiometer colour interval maps. The VLF-EM total-field and quadrature profiles are printed on the back of the magnetic anomaly and gradiometer colour interval maps, respectively. This presentation provides a means to view the VLF-EM data and the magnetics with the use of a light table. In addition, the digital data can be purchased for further processing and interpretation from the Geophysical Data Centre, Geological Survey of Canada, 1 Observatory Crescent, Ottawa, Ontario, K1A 0Y3, (613) 992-6438.

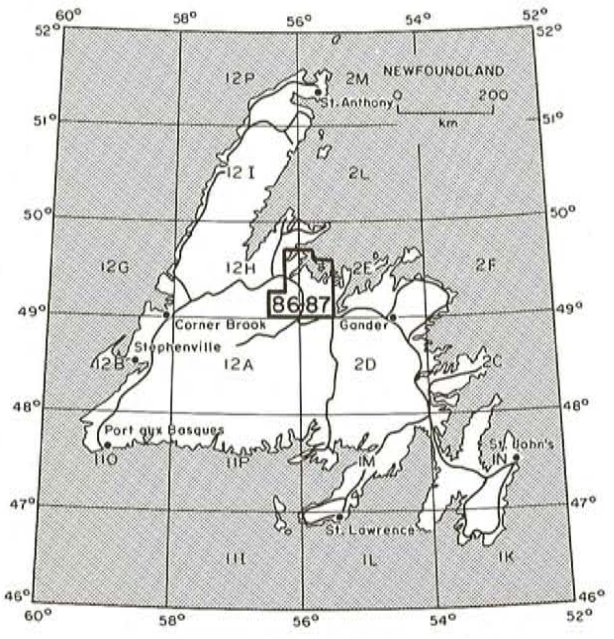

Figure 1. *High resolution aeromagnetic total-field, gradiometer and VLF-EM survey 1986-87, central Newfoundland.*

Plates 1 and 2 are photo reductions of the magnetic anomaly and gradiometer maps, respectively. Superimposed on each is an overlay emphasizing the major magnetic markers.

This project is a contribution to the Canada–Newfoundland Mineral Development Agreement, 1984–1989

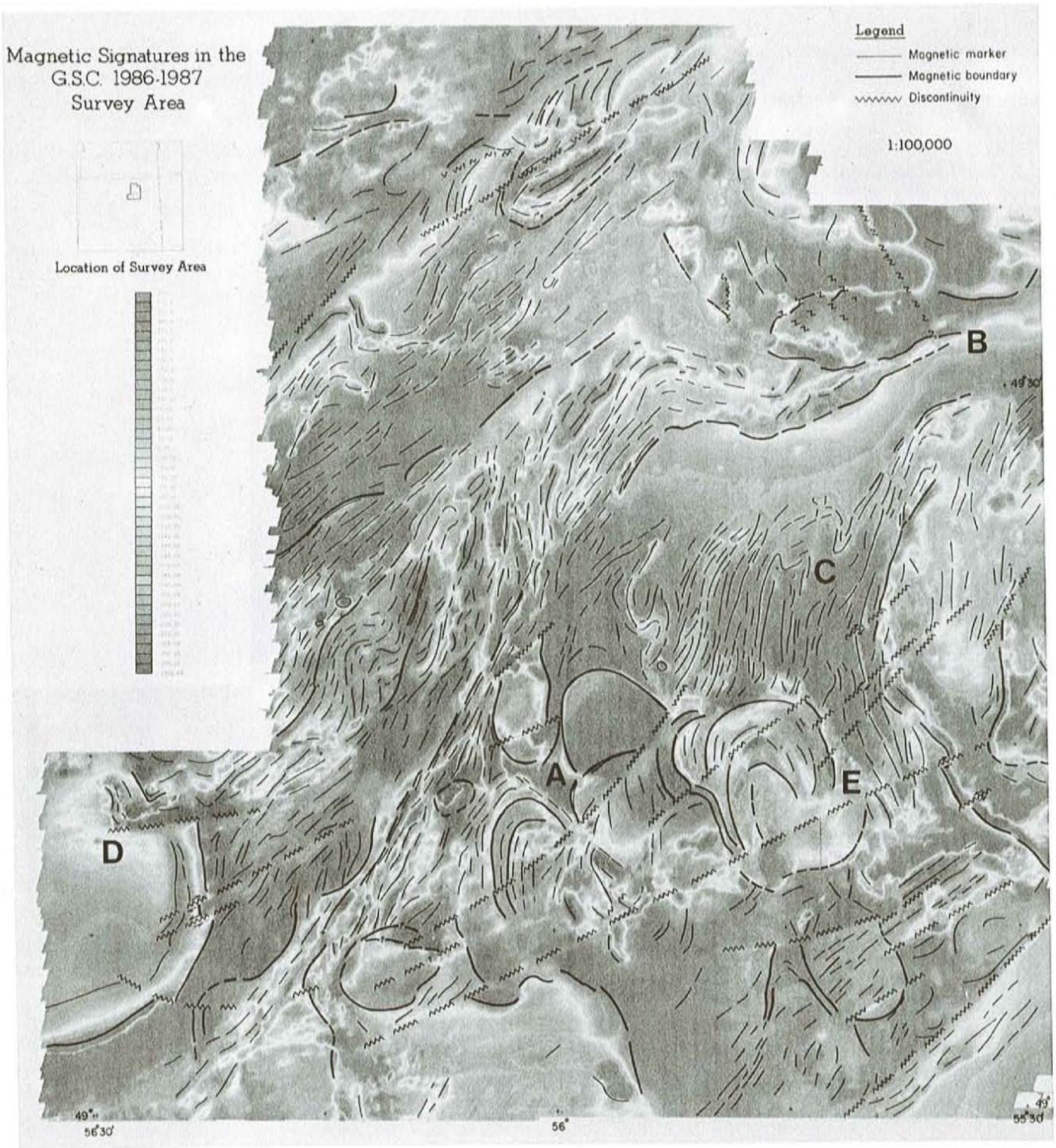

Plate 1. *Magnetic anomaly map with major magnetic markers outlined, central Newfoundland.*

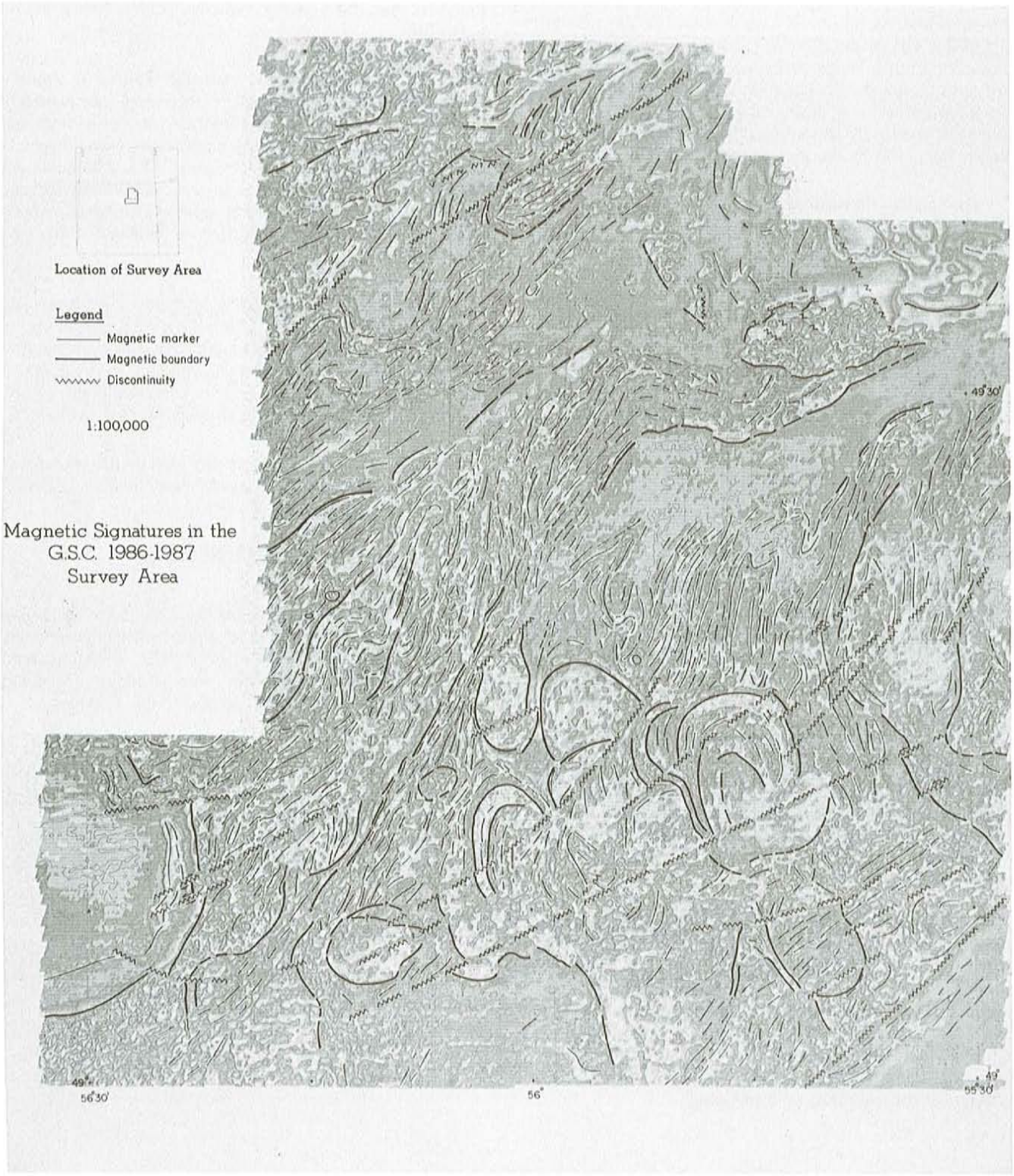

Plate 2. *Vertical gradient map with major magnetic markers outlined, central Newfoundland.*

RESULTS

In this central Newfoundland survey area, the magnetic signature confirms mapped geology (Dean, 1977) and provides additional details. A number of structural features stand out clearly on the gradiometer colour maps. Several phases of plutonic intrusion have occurred in the southern part of the survey and these are transected by more recent northeast-striking faults. A folded swarm of sills intrudes farther to the north. Near the top of the survey area, there is evidence of a thrust sheet. Although all of these features have been previously identified, the specific information on each is enhanced by the geophysical results.

The igneous intrusions in the south ('A', Plate 1), are Devonian (Dean, 1977), and are graphically outlined by the magnetics, but only to a lesser degree by the VLF-EM. They are identified by a horseshoe-shaped pattern, which characterizes the magnetic contrast along their perimeter. The Hodges Hill, Topsails, and Dawes Pond granites, as well as the Twin Lakes Diorite Complex contacts, are particularly well defined. Within certain intrusive units, there is a secondary magnetic signature indicating either magmatic differentiation or possibly, progressive stages of intrusion.

The gradiometer trace is particularly effective in identifying magnetic contacts, as is the case with the Devonian igneous intrusions described earlier. The zero gradiometer contour tends to lie directly above a magnetic contact in northern latitudes. For Newfoundland, this contour will be slightly offset due to the inclination of the earth's field, the effect of remanent magnetization and the interference from adjacent sources. VLF-EM anomalies are associated with both contrasts in conductivity between rock units, and cultural features. This survey area is dotted with bodies of water, swamps, creeks, etc., which complicate the interpretation of the VLF-EM signature.

In the north ('B', Plate 1), the ophiolitic rocks of the Lushs Bight Group are thrust faulted against the Silurian Springdale and Ordovician Roberts Arm groups (Kean, 1984). The magnetics trace this fault (Lobster Cove Fault) very clearly, where the basaltic pillow lavas are thrust against the Roberts Arm Group to the south. The sharpness of this delineation decreases westward.

Middle and Lower Ordovician diabase and gabbro sills intrude the Wild Bight Group southwest of Badger Bay ('C', Plate 1). The sills appear magnetically as a cluster of several, parallel to sub-parallel, folded, elongated anomalies. The contrast in magnetic response between these units is such that folding patterns can be readily traced. The vertical gradient indicates that the number and extent of these folded, north–northeasterly trending units is far greater than currently identified from field mapping.

The Topsails granite ('D', Plate 1) is located along the most westerly edge of the survey area. Immediately to the north, are the volcanics of the Silurian Springdale Group, which are alternately acidic and mafic units. The difference in magnetic signature between these alternating units, helps to define the Burnt Berry syncline, which trends to the northeast.

A post-Devonian period of major faulting is strongly evidenced in the magnetic data and these east–northeasterly faults ('E', Plate 1), such as Northern Arm, Long Pond, and Four Mile faults show up clearly (particularly where magnetic features are intersected at angles near 90°). The faults are extensive, readily evident and in several cases, clearly indicate transverse displacement. Several of these previously mapped faults can be extended or modified on the basis of this new information.

These structural and lithological features that have been highlighted are only those that are the most apparent on the 1:50,000 colour maps. Further qualitative details, in addition to a great deal of quantitative information, (e.g., depth to source rock, susceptibility, shape of causative body) can be derived from the 1:25,000 contour maps and the profile data.

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