Current Research (1986) Newfoundland Department of Mines and Energy
Mineral Development Division, Report 86-1, pages 251-256

GRAVITY SURVEYS IN INSULAR NEWFOUNDLAND, 1985

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INTRODUCTION

Gravity surveys were conducted as a co-operative project between the Department of Mines and Energy and Memorial University. Data were collected in five areas: Indian Bay Pond area of the northern Gander Zone, Ackley Granite area, Third Berry Hill Pond area, along the Burgeo road, and along a profile traversing the Mount Cormack Terrane (Figure 1).

All data were collected using a Lacoste - Romberg land gravity meter, G172. Elevations were determined by Wallace and Tiernan barometric altimeters using known topographic control elevations as bench marks. All elevations were tied to mean sea level by surveying from the water line and were corrected with reference to tide tables. Positions were taken from 1:50,000 scale topographic maps.

A total of 619 gravity readings were taken at 593 localities in the five areas surveyed, and 26 were at repeat stations. The data were reduced to Bouguer anomalies through the use of standard Canadian Network gravity bases which are in turn tied to the worldwide IGSN71 network. The theoretical gravity at each station was determined using the 1968 International Gravity Formula, and a crustal density of 2.67^{-3} g cm was used for the Bouguer slab correction. No terrain corrections were considered necessary. The resulting Bouguer anomalies are considered accurate to $\pm$ 0.5 mGal with the main contribution to the uncertainty arising from the 2 m uncertainty in the elevation, although in the Ackley Granite survey this accuracy deteriorates to $\pm$ 1 mGal due to an elevation uncertainty of $\pm$ 5 m.

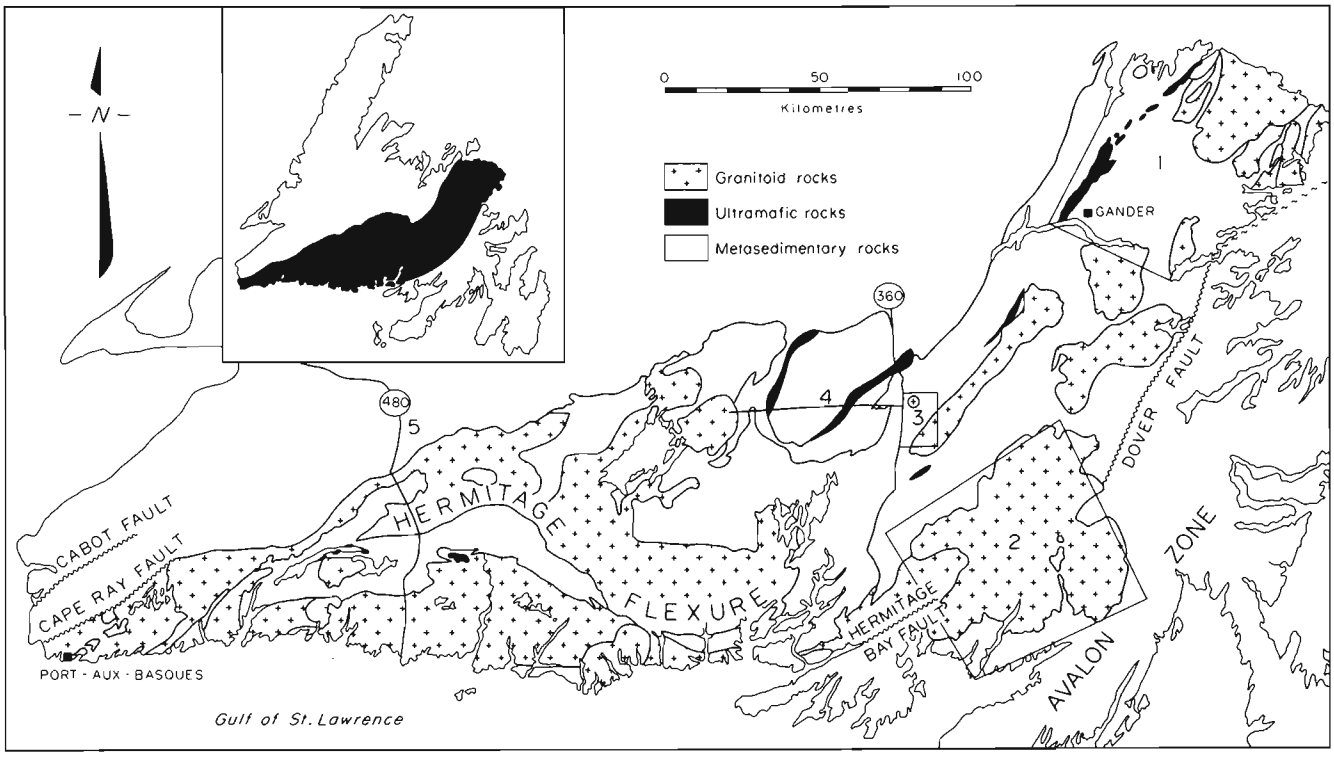

Figure 1: *Simplified geological map and survey location map for 1985 gravity surveys. Area 1 - Gander; Area 2 - Ackley Granite; Area 3 - Third Berry Hill Pond; Area 4 - Mount Cormack Terrane; Area 5 - Burgeo road.*

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

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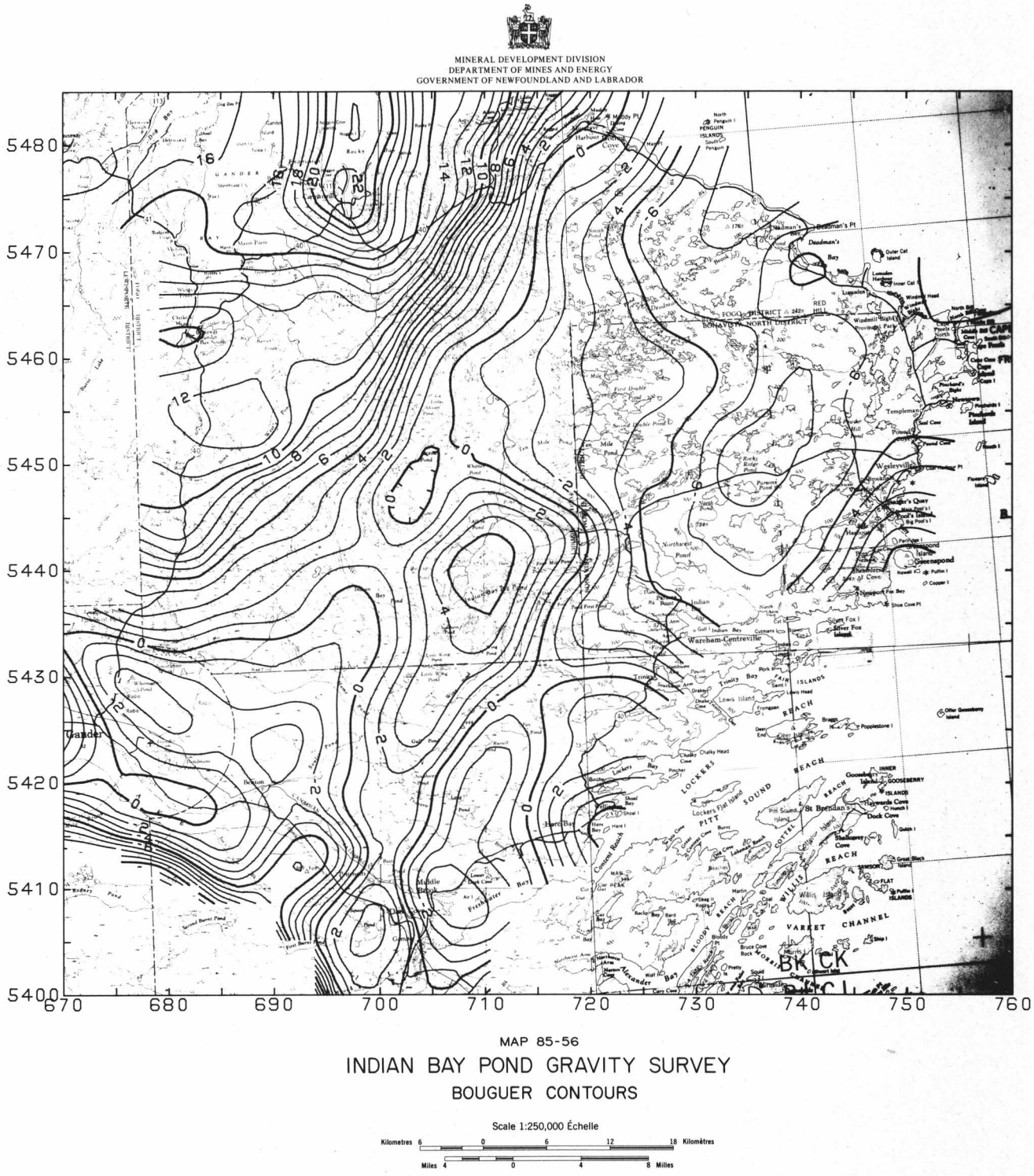

MAP 85-56

INDIAN BAY POND GRAVITY SURVEY

BOUGUER CONTOURS

Figure 2: *Bouguer anomaly contour map for Indian Bay Pond area. Co-ordinates are UTM Zone 21 co-ordinates in kilometres; contour interval 2.5 mGal.*

Indian Bay Pond Area

The Indian Bay Pond (Area 1, Figure 1) survey was conducted to provide additional geophysical data for delineating the belt of positive anomalies discovered by Miller and Weir (1982) and confirmed by a later pilot gravity survey (Butler *et al.*, 1984). During the 1985 field season an additional 251 stations were occupied in the area between the Trans Canada Highway in the south and Hamilton Sound in the north, and between the Gambo-Wesleyville road (Route 320) in the east and the Gander Bay road (Route 330) in the west (Figure 2). These data were compiled with the existing data collected by Weir (1971), Weaver (1967), and Miller (Miller and Weir, 1982), and released in open file form (Open File Nfld 1486).

The Bouguer anomaly map for the area is presented in Figure 2. Preliminary interpretation of the data, including aeromagnetic and geochemical data, indicate that the zone of positive Bouguer gravity anomalies commencing at co-ordinates 5400,710 can be followed northward to the vicinity of co-ordinates 5450,710, where they are abruptly terminated against the southern portion of the Deadman's Bay Granite (Strong *et al.*, 1974). These gravity anomalies have a coincident magnetic low in the north where there are also geochemical anomalies in copper, nickel, lead, cobalt and zinc. These anomalies occur in an area of limited outcrop in which there are some volcanic rocks and associated volcaniclastics (Blackwood, 1978; Wonderley and Neuman, 1984). The gravity anomaly containing a steeper eastern gradient in the vicinity of coordinates 5440,710 supports the thrust interpretation of Wonderley and Neuman (1984). The continuity of the anomaly pattern southward suggests that the volcanic rocks occur in the positive anomaly belt and extend to the southern boundary of the study area.

The combined geophysical and geochemical signatures associated with particular geological units in this study suggest that the combining of regional surveys may be a powerful tool in interpreting the geology in areas of limited outcrop. This point will be pursued further in interpreting the data using statistical correlation methods. The data will also be interpreted using standard geophysical modelling techniques to determine the attitude and subsurface extent of a possible thrust slice.

Ackley Granite Area

A pilot survey was carried out in 1983 (Miller, 1984) to determine the subsurface extent of the Ackley Granite using gravity data along two main traverses. To complement this survey, 131 stations, spaced 5 km apart along six traverses, were occupied across the granite during the 1985 field season, adding to the existing data base of 52 stations occupied in 1983 (Area 2, Figure 1). The Bouguer anomaly contour map resulting from the complete data set, which has been released as Open File Nfld 1487, is presented in Figure 3. The data demonstrate that the gravity field over the granite varies considerably and exhibits correlation with the various map units determined by Dickson (1983) and O'Brien *et al.* (1984). In particular, the region in which the roof pendants are found (in the vicinity of coordinates 5315,670) is the location of a relative gravity high, indicating that the granite is much thinner there. The thickest portion of the granite is in the southwestern part of the study area where the gravity anomalies are as low as -19.7 mGal. This thicker portion of the granite extends north with another pronounced gravity low centered at 5325,650. Between this low and the southern low, there is a ridge in the gravity data which approximately coincides with a major boundary in the geochemical trends and in the geological units (Dickson, 1983; O'Brien *et al.*, 1984). The trace of the Dover Fault (Blackwood and O'Driscoll, 1976) and its assumed continuation, the Hermitage Bay Fault, are readily recognized by the linear patterns in the southwestern and northeastern parts of the survey area.

The aeromagnetic data for the area are being digitized and will be processed and used to interpret the boundaries of the granite where no gravity data are available. The magnetic susceptibility and density have been determined for all the samples used in the geochemical assessment of the area (Dickson, 1983; Tuach, 1984), enabling the complete geophysical and geochemical data bases to be used in the interpretation of the area. The statistical correlations between these data will be examined to further develop techniques of assessing combined geophysical and geochemical regional data. Geophysical modelling and inversion methods will be used to ascertain the subsurface configuration of the granite. The general conclusion, based on the preliminary interpretation, is that there is an excellent correlation between the geological and geophysical data. This will ensure that the interpreted thickness for various portions of the area will be reliable, especially since the physical properties are so well known.

Third Berry Hill Pond and Mount Cormack Terrane Area

Gravity data were collected during 1985 at 56 stations in the Third Berry Hill Pond area (Area 3, Figure 1). These data were supplemented by data from a previous survey to produce the Bouguer anomaly map for the area (Figure 4; Open File 2D (155)). The objective of this survey was to collect sufficient data over the Third Berry Hill Pond granite (Blackwood, 1983) to determine the surface and subsurface extent of the granite using geophysical methods in an area of poor exposure. A preliminary examination of the gravity, magnetic, and geological data suggests that the granite extends in the subsurface to the southwest. The combined geophysical data indicate that the boundaries of the other geological units may also be better determined. Further interpretation will be conducted when the data from other reports on the area are incorporated into the data base.

An additional 22 stations were occupied along an east-west line from the Bay D'Espoir highway (Route 360) west to Great Burnt Lake to examine the gravity signature of the Mount Cormack Terrane (Colman-Sadd and Swinden, 1984). These data will be combined with the aeromagnetic data to model the subsurface extent of the ophiolitic bodies in the area. Preliminary examination of the gravity data indicates that the gravity high regions correlate, as expected, with the areas of known ophiolite outcrop.

Burgeo Road Area

A survey consisting of 159 stations at 1 km spacing was conducted along the Burgeo road (Area 5, Figure 1) to examine the correlation between the gravity data and the geologic units. The anomalies are negative for the first 12 km east from the intersection of the Burgeo road (Route 480) and the Trans Canada Highway, beyond which the anomalies are positive for 70 km. Within the latter region there are two zones of positive anomalies in excess of 25 mGal, one located approximately 25 km from the western end of the road and the second over the Annieopsquotch Mountains. South of the mountains the gravity anomalies are all negative. The Bouguer anomalies on this survey range from+31.9 mGal to −28.1 mGal. The gravity, magnetic, and geological data from this area will be combined to determine a crustal model for southwestern Newfoundland.

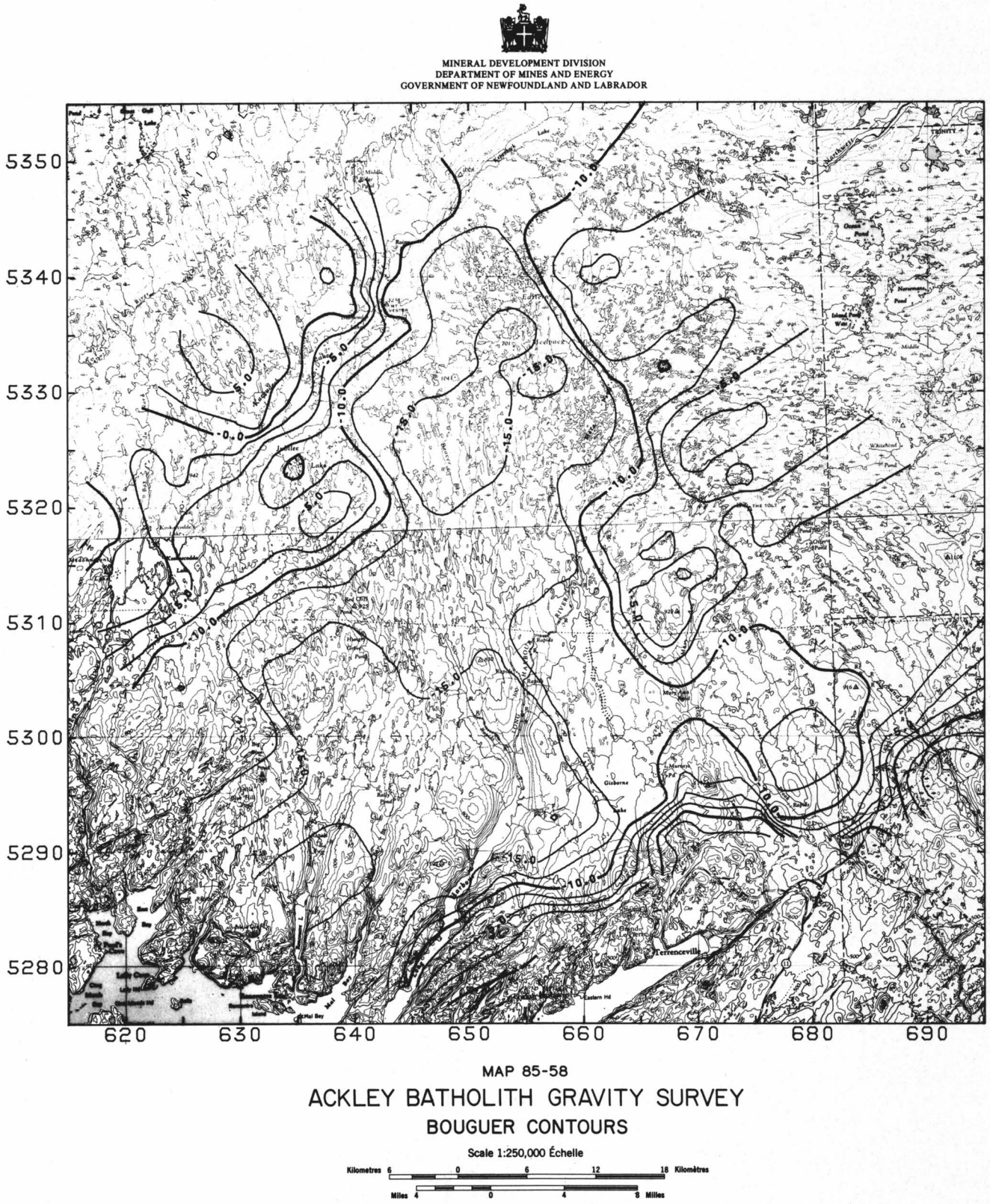

Figure 3: *Bouguer anomaly contour map for Ackley Granite area. Co-ordinates are UTM Zone 21 co-ordinates in kilometres; contour interval 2.5 mGal.*

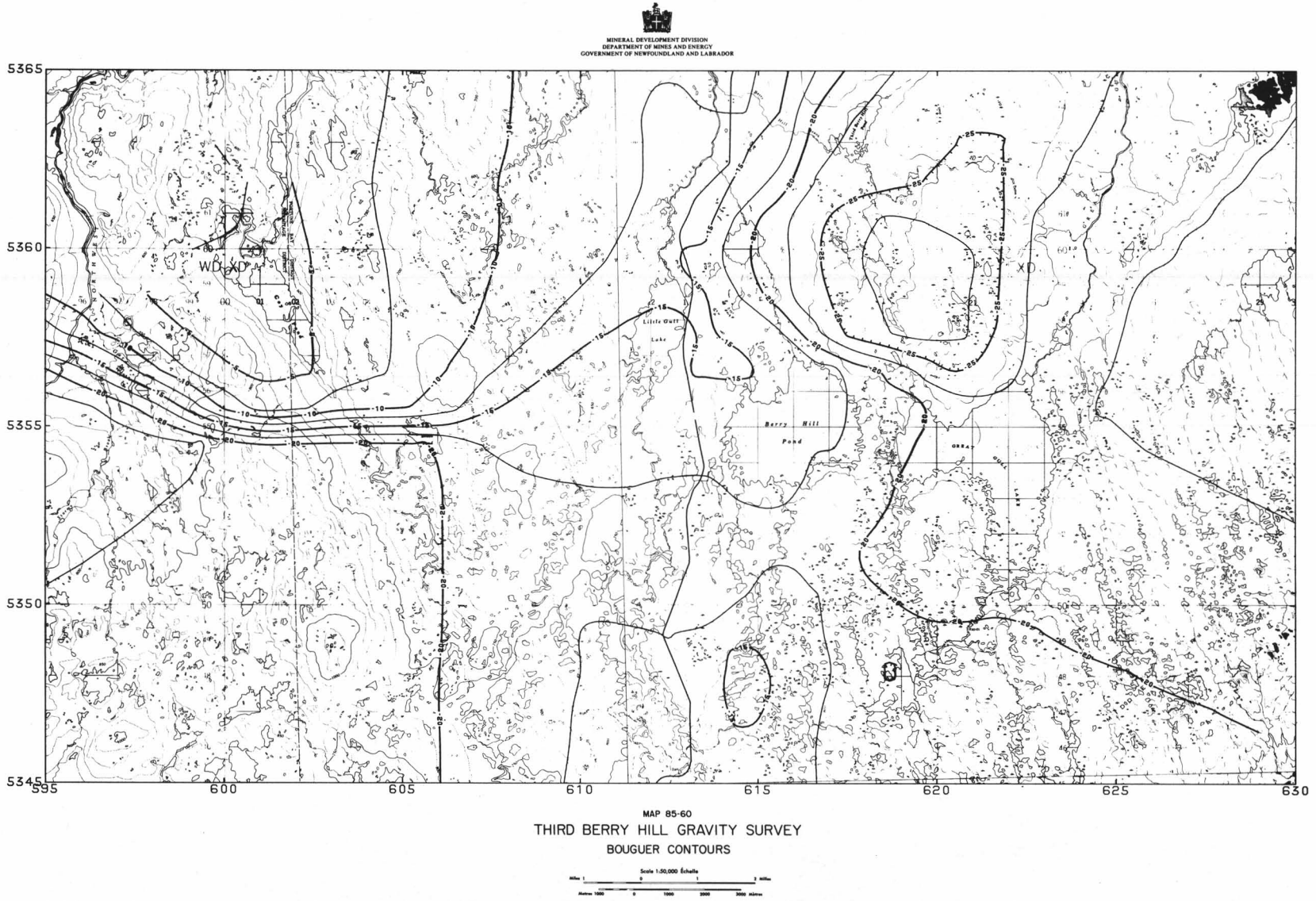

Figure 4: *Bouguer anomaly contour map for Third Berry Hill Pond area. Co-ordinates are UTM Zone 21 co-ordinates in kilometres; contour interval 2.5 mGal.*

Bouguer anomalies determined from all except the Burgeo road data have been released in Open File reports which also contain the gravity data from previous Memorial University and Earth Physics Branch surveys in the various areas. Publications dealing with the detailed interpretation of the various data sets are planned.

ACKNOWLEDGEMENTS

The author wishes to acknowledge and thank the field crew of Roger O'Regan, Ewan Cumming, and Tim Gregory who were responsible for the data acquisition in the field and for the reduction of the gravity data. John McConnell and Jim Butler are sincerely thanked for critically reading the manuscript.

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