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# GRAVITY MAP SERIES

of the

# DOMINION OBSERVATORY

## Preliminary Results of the Gravity Survey of the Island of Newfoundland with maps

No. 53—Avalon-Burin
No. 54—La Poile-Burgeo
No. 55—Notre Dame-Bonavista
No. 56—St. Georges-White Bay
No. 57—Harrington-Belle Isle

D. F. Weaver

OTTAWA, CANADA

Department of Energy, Mines and Resources
OBSERVATORIES BRANCH
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# PRELIMINARY RESULTS OF THE GRAVITY SURVEY OF THE ISLAND OF NEWFOUNDLAND

D. F. Weaver

## INTRODUCTION

During the summer of 1964, a Dominion Observatory field party occupied about 1200 regional gravity stations on the Island of Newfoundland. A full discussion and interpretation of the results of this survey are given elsewhere in a Publication of the Dominion Observatory by Weaver (1967).

This report presents five Bouguer anomaly maps at a scale of 1:500,000, a short discussion of the methods used to observe and reduce the anomalies, and the main results of the gravity interpretation.

## OBSERVATION AND REDUCTION OF DATA

All the connections between gravity control stations (except for a few of the excentre connections) were made by LaCoste and Romberg gravimeters, numbers G74 and G9. Most of the connections were made while establishing gas caches, and involved reading at one control station (A), flying to the second (B) and reading there, and then returning to read again at the first station (A), thereby forming an A-B-A connection. The remainder of the connections were simply A-B ties. After a least squares adjustment of the Newfoundland control network nearly all the residuals were less than 0.05 mgal.

The regional gravity stations were observed by traversing with Worden gravimeters (No. 391, 431, 546) between control stations. Single readings of the gravimeters were taken at each regional station. The observed gravity values for these stations have a standard error of less than 0.2 mgal.

Most of the elevations for the gravity stations were computed from altimeter readings taken concurrently with each gravity observation. Two Wallace and Tiernan altimeters were carried in each aircraft and were read at each gravity station. The altimeter readings were corrected for temperature, humidity and changes in barometric pressure. The latter were obtained from readings at successive points of known elevation and the calculations made on the assumption that atmospheric pressure varied linearly with time. A station of known elevation was normally occupied at least once every hour. Elevation control in Newfoundland was provided by sea level, bench marks, and barometric elevations supplied by the Surveys and Mapping Branch, Department of Energy, Mines and Resources, Ottawa.

An estimate of the uncertainty in the barometric elevations was made by calculating the rms dispersion of barometric ties to mean sea level from inland points of known elevation. An analysis of 279 such connections in Newfoundland showed an rms dispersion of 15 feet, which corresponds to an error of $\pm 0.9$ mgal in the Bouguer anomalies.

The latitude and longitude of the gravity stations were scaled to an accuracy of $\pm 0.1$ min from 1:250,000 maps supplied by the Surveys and Mapping Branch, Department of Energy, Mines and Resources, Ottawa. The corresponding error in the Bouguer anomalies is $\pm 0.15$ mgal.

The Bouguer anomalies were reduced using the conventional density of 2.67 g/cm$^3$ for the crustal rocks, instead of 2.69 g/cm$^3$, the average density of all rock samples collected during the survey. The use of the higher density of 2.69 g/cm$^3$ in the reduction would alter the Bouguer anomalies by only 0.25 mgal per 1000 feet of elevation. Terrain corrections have not been applied to the gravity data. Terrain effects were minimized by careful choice of station location by the observers during the course of the survey (Tanner and McConnell, 1964). It is estimated that 60 to 80 per cent of the stations in Newfoundland require a terrain correction of less than 1 milligal, and that 95 per cent or more require a correction under 5 mgal.

In conclusion, it is believed that the error in the plotted Bouguer anomaly values is generally less than 2 milligals.

The principal facts for all the gravity stations used in this report and location sketches of the control stations are available upon request from the Gravity Division, Dominion Observatory, Ottawa, Canada.

## SUMMARY OF RESULTS

The results reveal a major gravity gradient across a line that trends northeasterly over the southern part of the Great Northern Peninsula. This line may mark the boundary between the Grenville and Appalachian geological provinces. The anomalies north of this line average about 30 mgal less than the anomalies to the south. Seismic work suggests a thinner lower-density crust in the north where the anomalies are negative, and a thicker higher-density crust in the south where the anomalies are generally positive. Calculations show that the results are compatible with the gravity data if density variations in the upper mantle contribute to the gravity field. In neither area does there appear to be any dependence of Bouguer anomaly on elevation.

A correlation of the local Bouguer anomalies with the surface geology suggests that granite is the prime cause of the negative anomalies in Newfoundland. The sediments, most of which are metamorphosed, appear to have very little effect on the gravity field. Most of the positive anomalies correlate with large bodies of diorite or with gabbroic and ultrabasic intrusions. It is suggested that many of the longer wavelength regional variations in the gravity field are produced by changes in the crustal parameters at depth.

## REFERENCES

Tanner, J.G., and McConnell, R.K.
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