Gravitational Interpretation and Modelling of the South Mountain Batholith, Southern Nova Scotia

by

Marten Douma

Submitted in partial fulfillment of

the requirements for the degree of

Bachelor of Science - Honours

at

Dalhousie University

Halifax, Nova Scotia

March 15, 1978

DEPARTMENT OF GEOLOGY
DALHOUSIE UNIVERSITY
HALIFAX, NOVA SCOTIA
CANADA
B3H 4J1

DALHOUSIE UNIVERSITY, DEPARTMENT OF GEOLOGY

B.Sc. HONOURS THESIS

Author: Marten Douma

Title: Gravitational Interpretation and Modelling of the South Mountain Batholith, Southern Nova Scotia

Signature of author

Date: March 15, 1978

Distribution License

DalSpace requires agreement to this non-exclusive distribution license before your item can appear on DalSpace.

NON-EXCLUSIVE DISTRIBUTION LICENSE

You (the author(s) or copyright owner) grant to Dalhousie University the non-exclusive right to reproduce and distribute your submission worldwide in any medium.

You agree that Dalhousie University may, without changing the content, reformat the submission for the purpose of preservation.

You also agree that Dalhousie University may keep more than one copy of this submission for purposes of security, back-up and preservation.

You agree that the submission is your original work, and that you have the right to grant the rights contained in this license. You also agree that your submission does not, to the best of your knowledge, infringe upon anyone's copyright.

If the submission contains material for which you do not hold copyright, you agree that you have obtained the unrestricted permission of the copyright owner to grant Dalhousie University the rights required by this license, and that such third-party owned material is clearly identified and acknowledged within the text or content of the submission.

If the submission is based upon work that has been sponsored or supported by an agency or organization other than Dalhousie University, you assert that you have fulfilled any right of review or other obligations required by such contract or agreement.

Dalhousie University will clearly identify your name(s) as the author(s) or owner(s) of the submission, and will not make any alteration to the content of the files that you have submitted.

If you have questions regarding this license please contact the repository manager at dalspace@dal.ca.

Grant the distribution license by signing and dating below.

______________________________ ______________________________

Name of signatory Date

Abstract

Much controversy surrounds the issue of the geometry of the South Mountain Batholith of southern Nova Scotia. Gravity data released by the Department of Energy, Mines and Resources within the last year has allowed a reinterpretation and clarification of previously obscure information. This study was undertaken to define more clearly the subsurface geology of the South Mountain Batholith using the latest information. Data were interpreted on the basis of rock types observed in the field, especially with regard to their specific gravity.

A Bouguer Anomaly contour map reveals the presence of a large gravimetric low from Yarmouth to Sheet Harbour, a distance of nearly 300 kilometers. The low can be subdivided into three relatively intense depression two of which have been previously mapped as adamellite (quartz monzonite). Preliminary reconnaissance and sampling were carried out during the summer of 1977 in the third area, a region southwest of Kejimkujik National Park. Petrographic and gravitational analysis indicate that it, too, is adamellite.

The density contrast between the adamellite (S. G. 2.63) and the remaining areas of granodiorite (S. G. 2.68) is sufficiently large to allow specific gravity to be used as one of the variables in testing an interpretive model of the dimensions of the batholith.

Using known or implied surface contacts, two and three dimensional models were tested. By altering the subsurface geometry of the models, it was possible to approximate the observed gravity with the gravity generated by the hypothetical model and thereby approach a possible shape for the batholith.

Acknowledgements

I would like to express my thanks to Dr.M.J.Keen for suggesting the thesis topic, and for his academic and financial support. Contributions made by Dr.D.J.W. Piper, in his capacity as Acting Supervisor, are gratefully acknowledged.

Brant Laidler's assistance in the field was very much appreciated, as was the advice and encouragement of members of the faculty and staff of Dalhousie University and Bedford Institute of Oceanography.

Special thanks to Louisa Horne for her patience in typing the thesis.

Contents

Title	Page
Abstract	(ii)
Acknowledgements	(iv)
Figures	(vi)
Tables	(vi)
Introduction	1
Petrology	6
Density Relationships	12
Two Dimensional Computer Models	16
Three Dimensional Computer models	20
Summary of Two and Three Dimensional Models . . .	24
Mineralization	29
Conclusions	30
References	31
Appendix I : Density Determinations	33

Figures

Page

1. South Mountain Batholith 2

2. South Mountain Batholith and Bouguer Gravity Anomaly 3

3. Adamellite Bodies 7

4. Ice Flow Pattern 9

5. Density Contour Map 15

6. Cross Section Locations 17

7. Two Dimensional Models 19

8. Observed and Modelled Geology 21

9. Measured and Modelled Gravity 23

10. Comparison of Profile C-CC 25

11. Modelled Geometry of the South Mountain Batholith . . . 26

Tables

1. Average Densities 13

I-1 Densities of Specific Rock Types 35

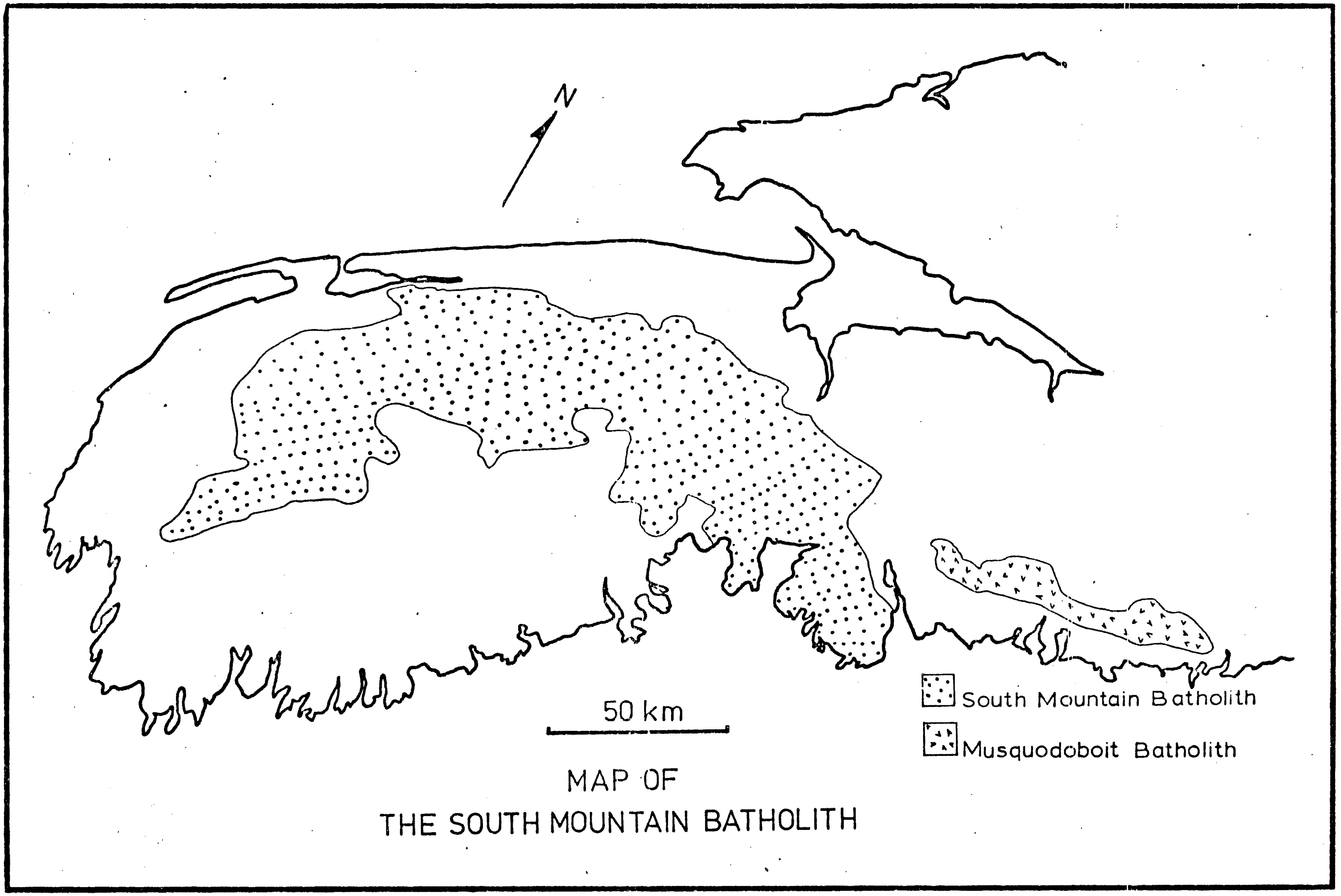
Introduction

The object of this study was to reinterpret the geometry of the South Mountain Batholith in the light of gravimetric observations made by the Department of Energy, Mines and Resources in 1976.

The South Mountain Batholith outcrops over a large portion of southwestern Nova Scotia. (Figure 1.) It was emplaced in the Middle to Late Devonian, during the latter stages of the Acadian Orogeny. The batholith is composed of adamellite, granodiorite and a series of minor intrusions. Adamellite contains calcium bearing feldspar, frequently oligoclase, and potassium feldspar in approximately equal amounts, along with quartz, muscovite and biotite. The more calcic granodiorite contains subequal amounts of quartz and plagioclase, with lesser amounts of potassium feldspar and biotite.

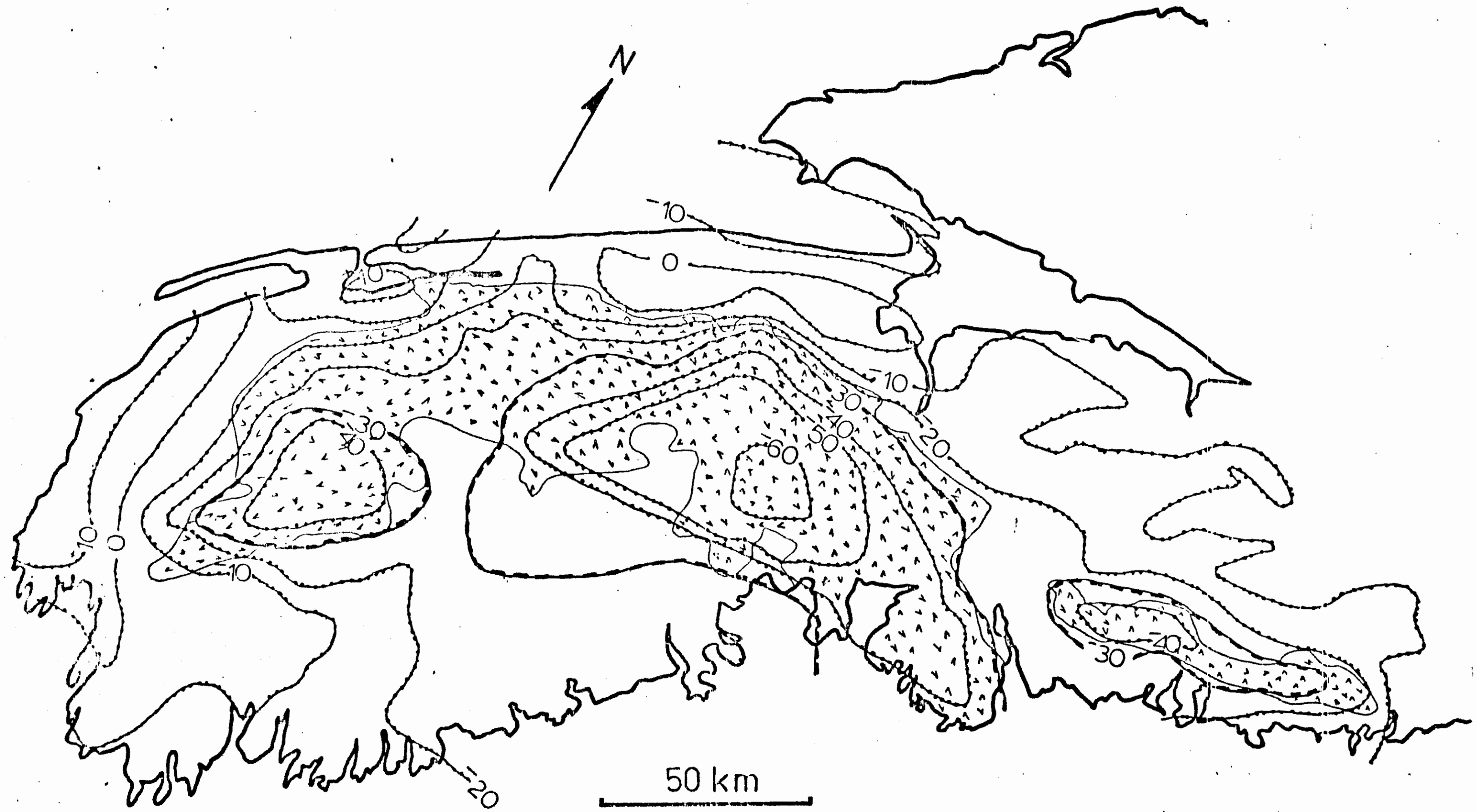
Clarke *et al.* (1978) determined an age of 372±2 million years for the granodiorite and a combined isochron age of 359±1 million years for the twelve whole rocks from the New Ross-Vaughan igneous complex. Metasedimentary rocks enclosing the batholith indicate an age of 370 million years, this being the time at which the strontium isotope clocks were reset by contact metamorphism.

The correlation between geology and gravity is demonstrated in figure 2. Generally, a gravity field is depressed over a low density region. Since granites are



N
50 km
South Mountain Batholith
Musquodoboit Batholith
MAP OF
THE SOUTH MOUNTAIN BATHOLITH

FIG. 1



MAP OF
THE SOUTH MOUNTAIN BATHOLITH
AND BOUGUER GRAVITY ANOMALY

FIG. 2

somewhat mass deficient in relation to average crustal densities, we expect to see a negative anomaly over regions of granitic intrusion.

Until two years ago the only comprehensive study of gravity in Nova Scotia was work done by Garland in 1953. His objective of evaluating the structure of the South Mountain Batholith was hampered by the lack of access in the western part of the province.

Garland's models indicated that the intrusion consisted of a vertical cylinder, 29 kilometers in depth and 59 kilometers in diameter, centred in the New Ross area. To explain the extensive area of more moderate negative gravity anomaly, Garland modelled a slab of granite, some 5 kilometers in thickness, alternately overlying and underlying Meguma metasediments.

Seismic determinations by Dainty *et al*. (1966) have shown the crust of the earth to be approximately 30 to 35 kilometers thick beneath the continental shelf off Nova Scotia, with a gradual increase to 40 to 45 kilometers beneath the Carboniferous Basin of the Gulf of St. Lawrence. Garland's model, would therefore, place the floor of the intrusion near the lower limit of the crust.

In 1975, O' Reilly reinterpreted Garland's gravity observations in terms of recent petrological studies, particularly with respect to the inhomogeneity of the batholith. His conclusions about the subsurface geometry are still largely valid, except for the far southwestern part of the batholith. He suggested that the batholith consisted of an elliptical mass of granodiorite, 15 to 20 kilometers deep, within which lay adamellite bodies of equivalent depth.

The intent, therefore of this author, is to reinterpret the previously proposed models in the light of recent developments in the petrology and gravity expression of the South Mountain Batholith and to generate a new model for the subsurface geometry of the batholith.

Petrology

The South Mountain Batholith, as mapped by McKenzie (1974), is composed of four adamellite bodies, ranging in size from 120 kilometers^2 to 500 kilometers^2, apparently enclosed in an older envelope of granodiorite (Figure 3). A series of minor, late stage intrusions is associated with the adamellite.

McKenzie defines the adamellite as possessing both biotite and muscovite, with plagioclase representing 33% to 67% of the feldspar content. The granodiorite, according to McKenzie, contains biotite as the primary mica, and plagioclase constitutes approximately 67% of the feldspar content.

A fifth possible adamellite pod, within the batholith proper, has been recognized by this author in the area southwest of Kejimkujik National Park. Evidence for this adamellite is limited, since there is no solid outcrop, only float. Previous workers in this area (Taylor, 1969; Smitheringale, 1973) have also commented on the paucity of bedrock exposure in the southwestern portion of the province. Adamellite samples were taken from very large, sometimes semi-buried, boulders.

These boulders are unlikely to have been moved very far by glacial action. Nielsen (1976) demonstrated that the main phase of Wisconsinan glaciation was directed toward the south. Pebble and heavy mineral distribution indicate that the ice sheet flowed around topographic highs

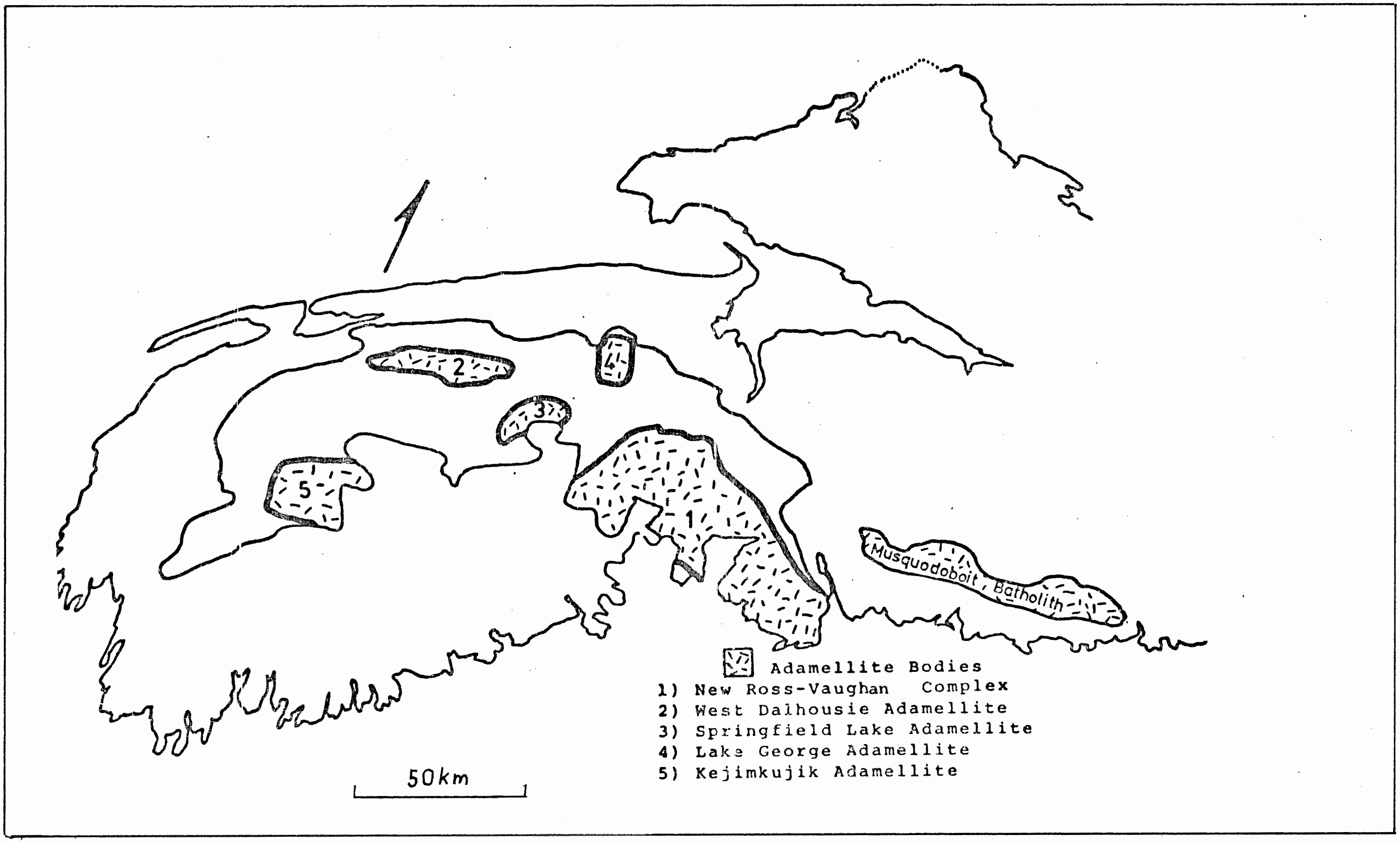

1
2
3
4
5
Musquodoboit Batholith
Adamellite Bodies
1) New Ross-Vaughan Complex
2) West Dalhousie Adamellite
3) Springfield Lake Adamellite
4) Lake George Adamellite
5) Kejimkujik Adamellite
50km

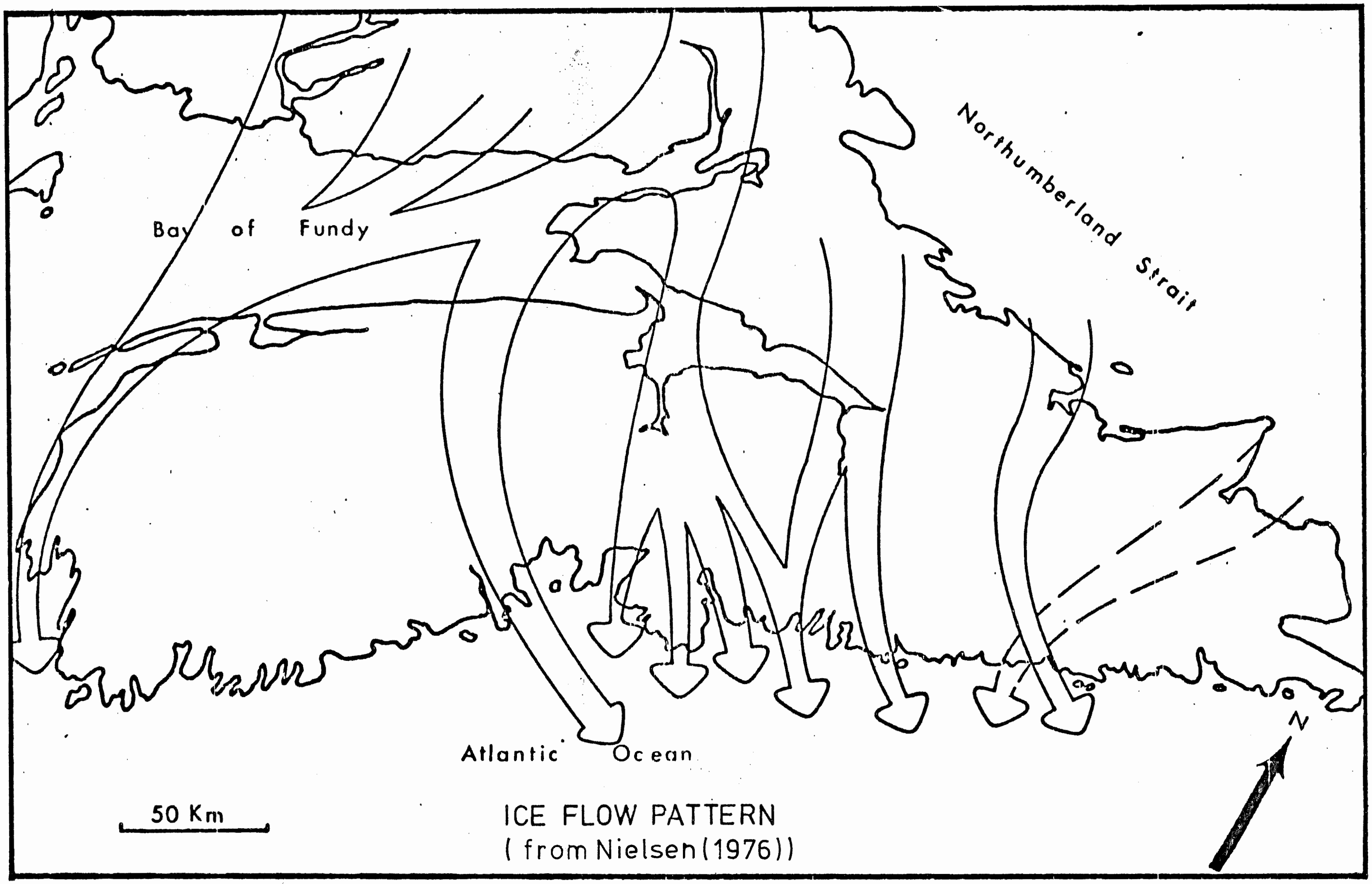
FIG. 3

to some extent. Ice flowing into the valley between the North Mountain and the South Mountain was deflected to the east and west, with little, if any, basal motion of ice over the uplands of the Kejimkujik area. (Figure 4). There is no known source to the north. The West Dalhousie adamellite is unlikely as a source since it is within the trough through which ice moved in an eastward direction. Also, erosian by glaciation is minimal in topographic lows. It would therefore, appear that the Kejimkujik erratics are very close to their site of inrusion. Gravity data show an extensive negative gravity anomaly over the Kejimkujik area, thus further supporting the presence of adamellite in this portion of the batholith.

The Musquodoboit Batholith, to the east of the South Mountain Batholith, is also adamellite. Jones and MacMichael (1976) describe the batholith as consisting primarily of muscovite-biotite leucogrnite, but examination of modal analyses show it to conform with McKenzie's (1974) adamellite criteria. No associated granodiorite has yet been mapped.

Gravity work by MacKenzie (1976) suggests that the South Mountain Batholith and the Musquodoboit Batholith are connected at a depth of about 5.5 kilometers.

Examination of the aluminosilicate phase relations and alteration of feldspars by McKenzie (1974) indicates that final granitic emplacement occurred at fairly high crustal levels. The nearly ubiquitous occurrence



ICE FLOW PATTERN
(from Nielsen (1976))

FIG. 4

of xenoliths in the exposed portions of granodiorite would further support this view. He demonstrated that the final stages of crystallization of the adamellite occurred between 4 kilobars (10 kilometers) at 650°C and 0.5 kilobars (1.3 kilometers) at 800°C.

Buddington (1959) speculated that emplacement occurred in the transitional epizone-mesozone (6 to 8 kilometers). Neilson _et al_. (1976) determined that emplacement was in the brittle fracture zone of the upper crust, on the basis of sharp contacts between the batholith and the country rocks.

McKenzie (1974) describes the source of the magma to be a mixture of andesitic material from a subducting plate to the west, and a lower crustal partial melt. Underplating of the crust by this material was followed by its diapiric rise to the upper crust. The actual proportion of mantle to crustal magma is uncertain but strontium isotopes indicate that the amount of mantle material was small.

Differentiation of this emplaced magma by fractional crystallization would begin or continue during final emplacement, with the more peraluminous and hydrous phases such as adamellite, alaskite and pegmatite being concentrated toward the centre of the intrusion. Finally, sufficient density contrast would exist between the granodiorite residuum and the adamellite differentiate, to allow the lighter adamellite to rise to the roof of the batholith by plastic deformation of the granodiorite.

Density Relationships

Garland (1953) suggested that the negative gravity anomalies evident over a large portion of southwestern Nova Scotia might be due, at least in part, to the presence of granite. The number of available density determinations, however, was insufficient to enable him to assign a representative density to each lithology. He therefore chose limits of 2.60 and 2.65 grams/cubic centimeter for the "granitic" rocks and limits of 2.70 and 2.75 grams/cubic centimeter for the slates and quartzites of the Meguma country rocks.

Garland noted that since granitic intrusions were characteristically variable in composition, his assumption about the density of the batholith might be in error. Table 1 shows the average densities of material relevant to this study, with sources as noted. (See appendix also.)

Seawater and North Mountain basalt densities are included, since their presence in computer models minimizes variations between observed and calculated gravity anomalies at the edges of models.

O'Reilly (1975) calculated the density of adamellite and granodiorite from a set of McKenzie's (1974) modal rock analyses.

By assuming equal amounts of slate and quartzite, O'Reilly calculated the mean density of the Meguma country rock to be 2.735 grams/cubic centimeter. This figure would

Table 1

	This Paper #	This Paper Rho	O'Reilly(1976) #	O'Reilly(1976) Rho	E,M+R(1976) #	E,M+R(1976) Rho	Modal #	Modal Rho	Adopted Value	Density Contrast
Meguma			95	2.73	30	2.73			2.73	0.00
Adamellite	11	2.64	36	2.63	10	2.61	10	2.61	2.63	-0.10
Granodiorite			23	2.68	10	2.68	11	2.68	2.68	-0.05
Basalt									2.85	+0.10
Sea Water									1.03	-1.70

be rounded downward to 2.73 grams/cubic centimeter owing to the apparent volumetric predominance of the lighter quartzites.

Sample locations were plotted on a map of the province in an attempt to generate a density contour map. (Figure 5). The deficiency of sampling within the South Mountain Batholith makes such an exercise difficult. Ideally a density map would reflect both lithology and gravity.

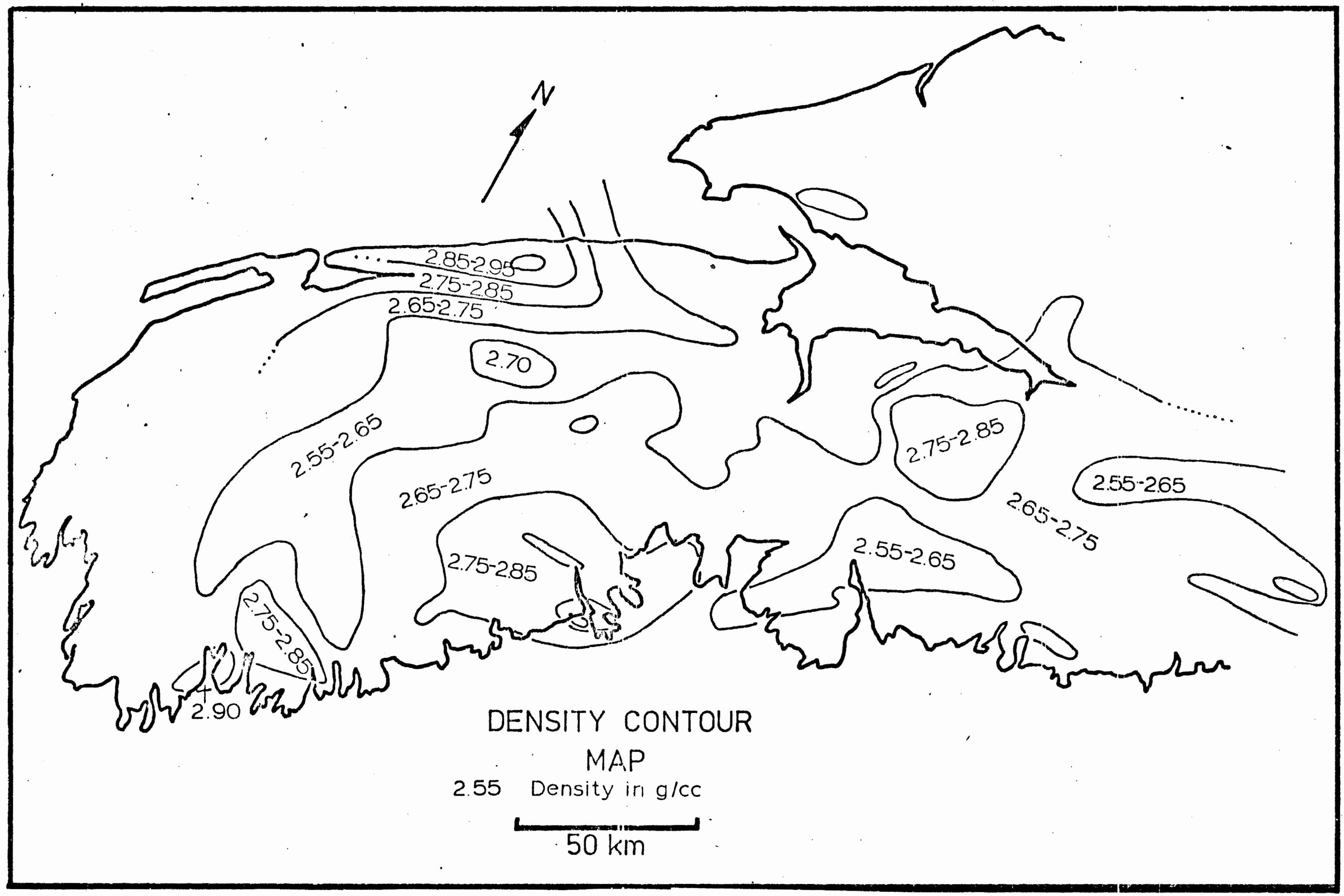

N
2.85-2.95
2.75-2.85
2.65-2.75
2.70
2.55-2.65
2.65-2.75
2.75-2.85
2.75-2.85
2.90
2.75-2.85
2.55-2.65
2.65-2.75
2.55-2.65
DENSITY CONTOUR
MAP
2.55 Density in g/cc
50 km

FIG. 5

Two Dimensional Computer Models

The geometry of the South Mountain Batholith was simulated using a series of two dimensional models. Each model consists of bodies of rock whose arrangement simulates the known or inferred geology. Two dimensional figures, representing sections through a body of rock, were defined by n-sided polygons and assigned a density contrast with a datum. To duplicate the cross section of any irregular body with improved accuracy, one has merely to increase the number of sides of the polygon.

Such two dimensional models are strictly valid only when applied to bodies whose lengths exceed their widths by an infinite amount. Nielson _et al_. (1976) indicate that a model is reasonable if the observed anomaly and the model generated anomaly show a close correlation, even if the model does not have a very large length to width ratio.

The two dimensional program's ease of use allows development of several models within a short period of time. Most of the operation can be conducted with a Tektronix cathode ray tube terminal which has graphics capability. This terminal is able to draw both gravity anomalies and the corresponding models.

Lines along which profiles of the geometry of the batholith were modelled are shown in figure 6. The lines intersect at New Ross, approximately 60 kilometers west of Halifax.

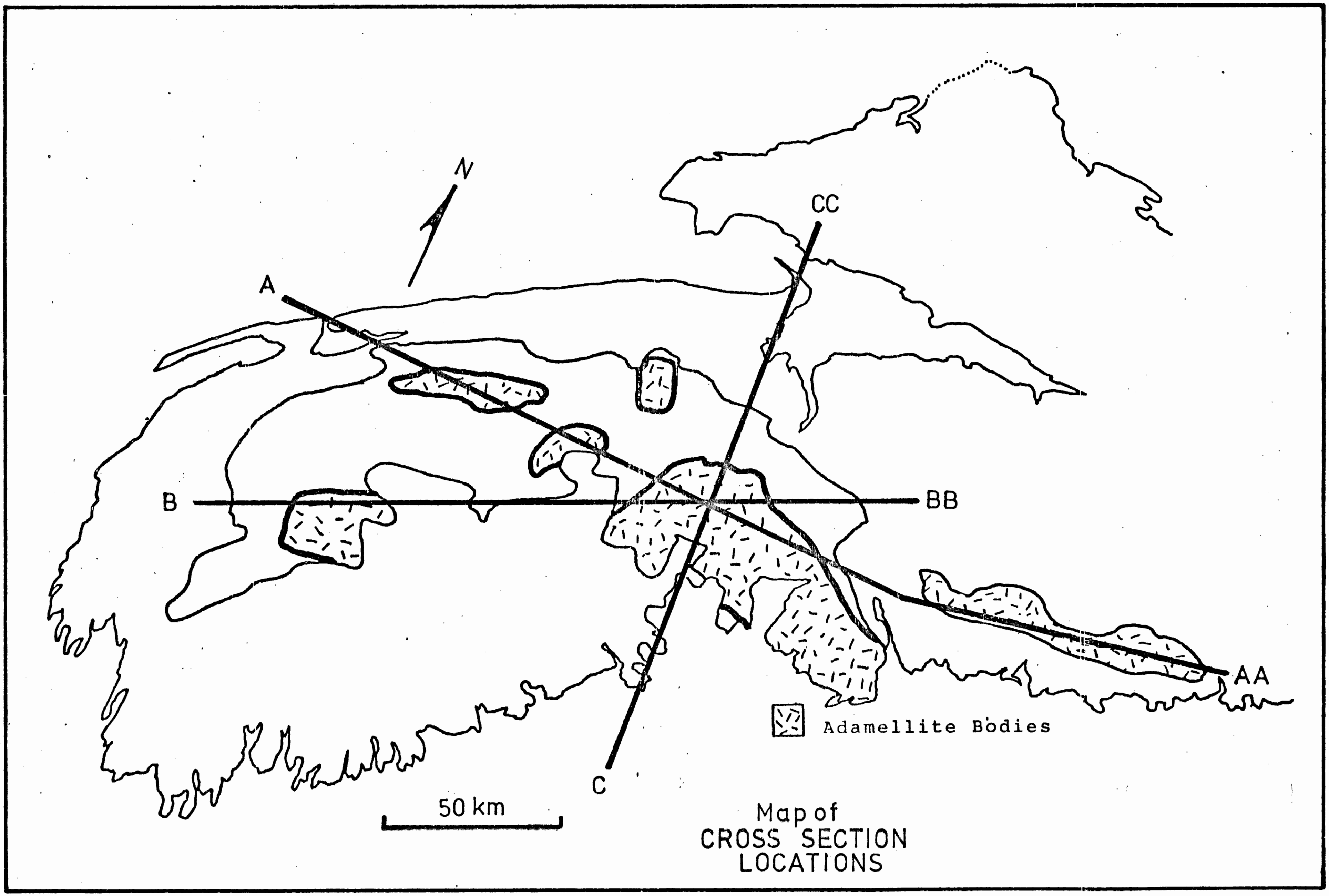
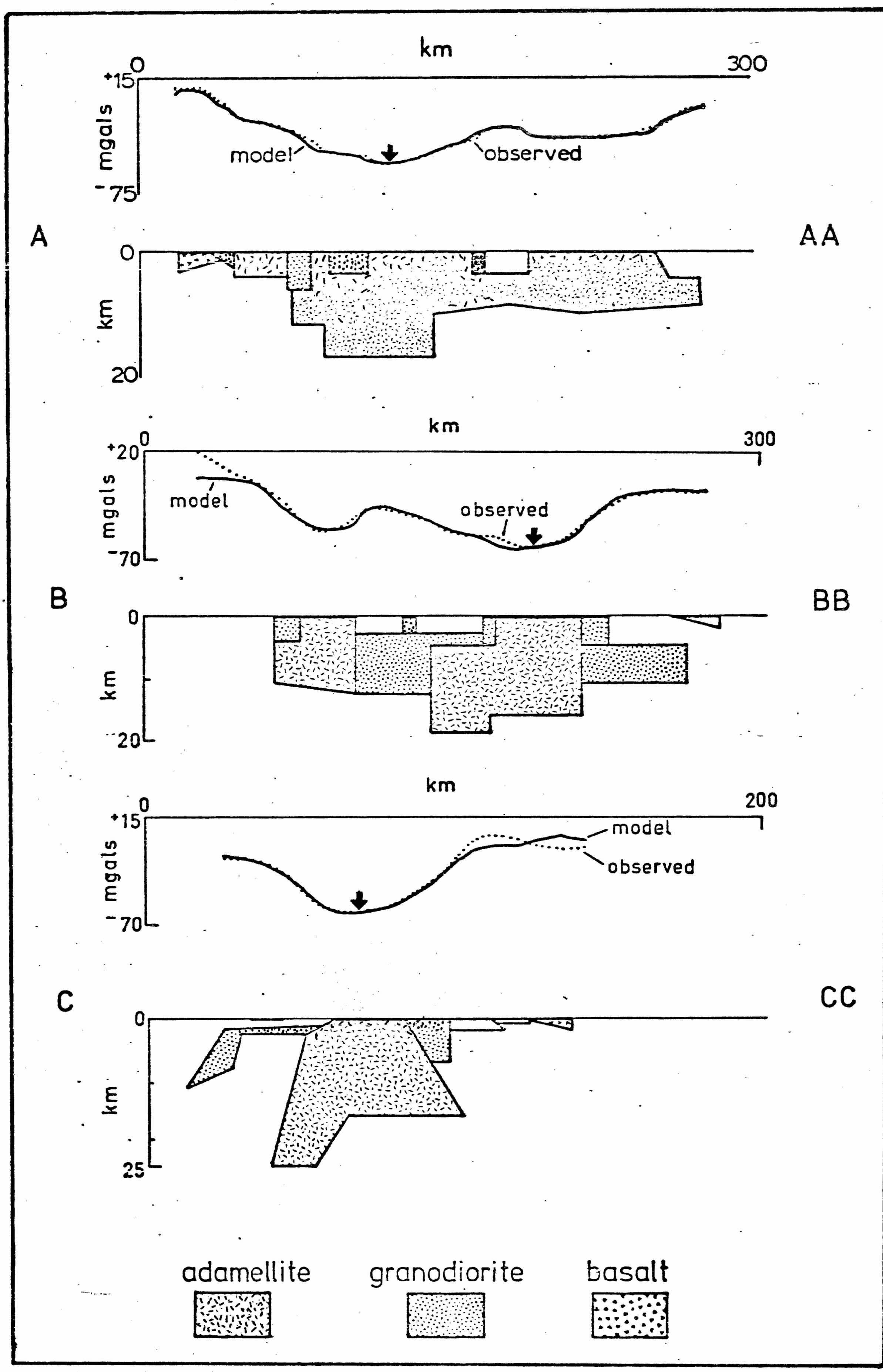

N
A
CC
B
BB
AA
C
Adamellite Bodies
50 km
Map of
CROSS SECTION
LOCATIONS

FIG.6

Figure 7 describes the two dimensional models constructed, and their corresponding anomalies as calculated by the Talwani et al. (1959) program. The program was modified by Ian Wells and Richard Haworth of the Bedford Institute of Oceanography to facilitate the use of graphics. The program is currently called Magrav.

The positon of New Ross is indicated by the broad arrow.



km
0
300
+15
mgals
-75
model
observed
A
AA
0
km
20
km
0
300
+20
mgals
-70
model
observed
B
BB
0
km
20
km
0
200
+15
mgals
-70
model
observed
C
CC
0
km
25
adamellite
granodiorite
basalt

FIG. 7

Three Dimensional Computer Models

Three dimensional gravity modelling involves calculating the gravity generated by a series of three dimensional blocks that are used to approximate bodies of rock. Following a program by Nagy (1964) the bodies are defined by prisms with sides parallel to an arbitrary Cartesian coordinate system. The greater the number of prisms, the more closely one can approximate the actual dimensions of a body. Again, the country rock is assigned a density datum of zero and other rock assumes a positive or negative specific gravity relative to the datum.

Figure 8 is a geology map of the South Mountain Batholith and its environs, upon which is superimposed a plan view of the prisms used to represent the simplified lithologies. In total, 72 prisms were used to approximate the geometry of the batholith and surrounding rocks. In most cases, several prisms defined portions of the same masses.

A more complete description of the operation of this program is to be found in O'Reilly's (1975) thesis, but a short summary of the procedure is as follows.

The gravity generated by each prism is calculated by the computer and summed at specified intervals parallel to the original Cartesian coordinate system used to define the prisms. The printed output of gravity is plotted and contoured by eye, although attempts were made to have the

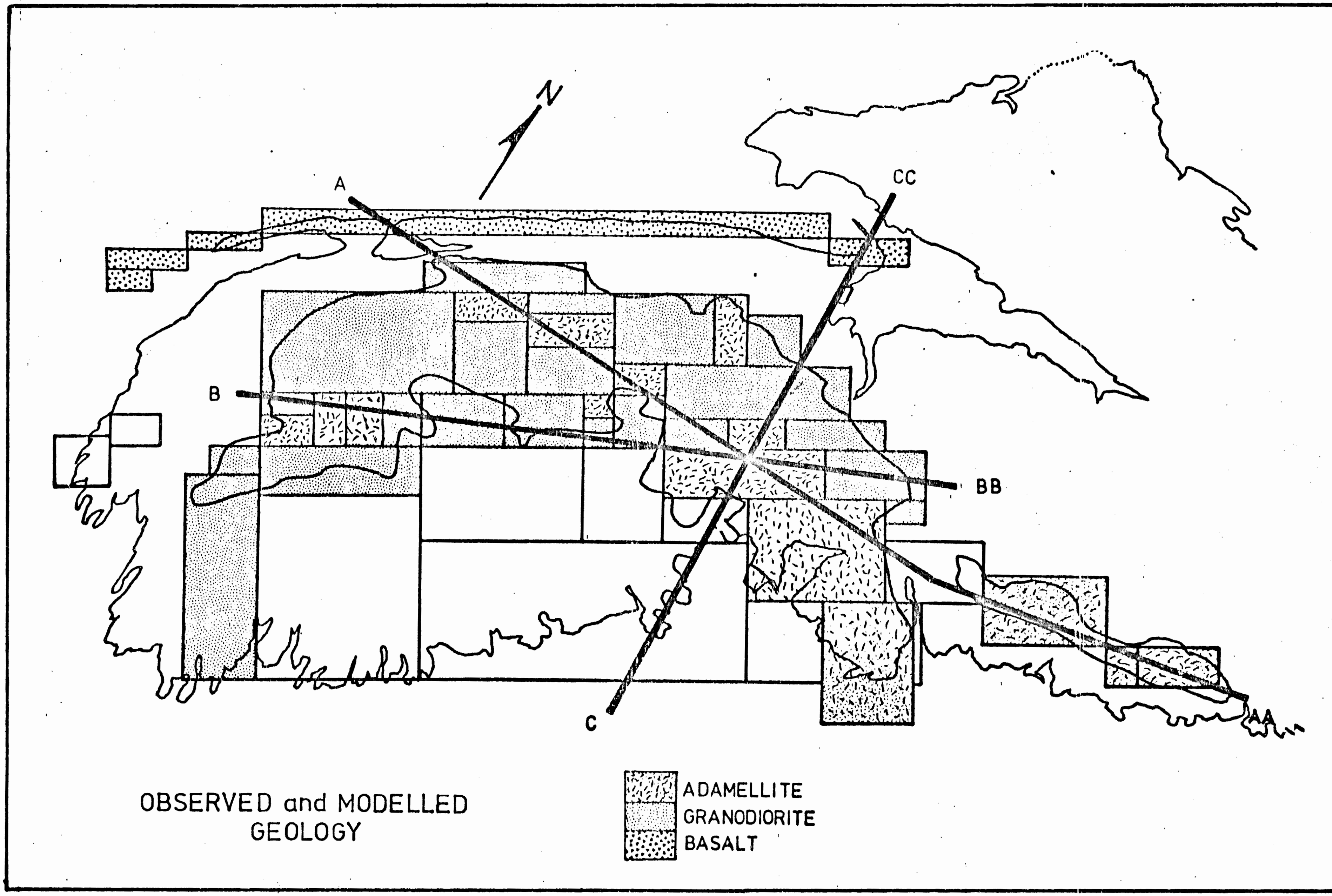
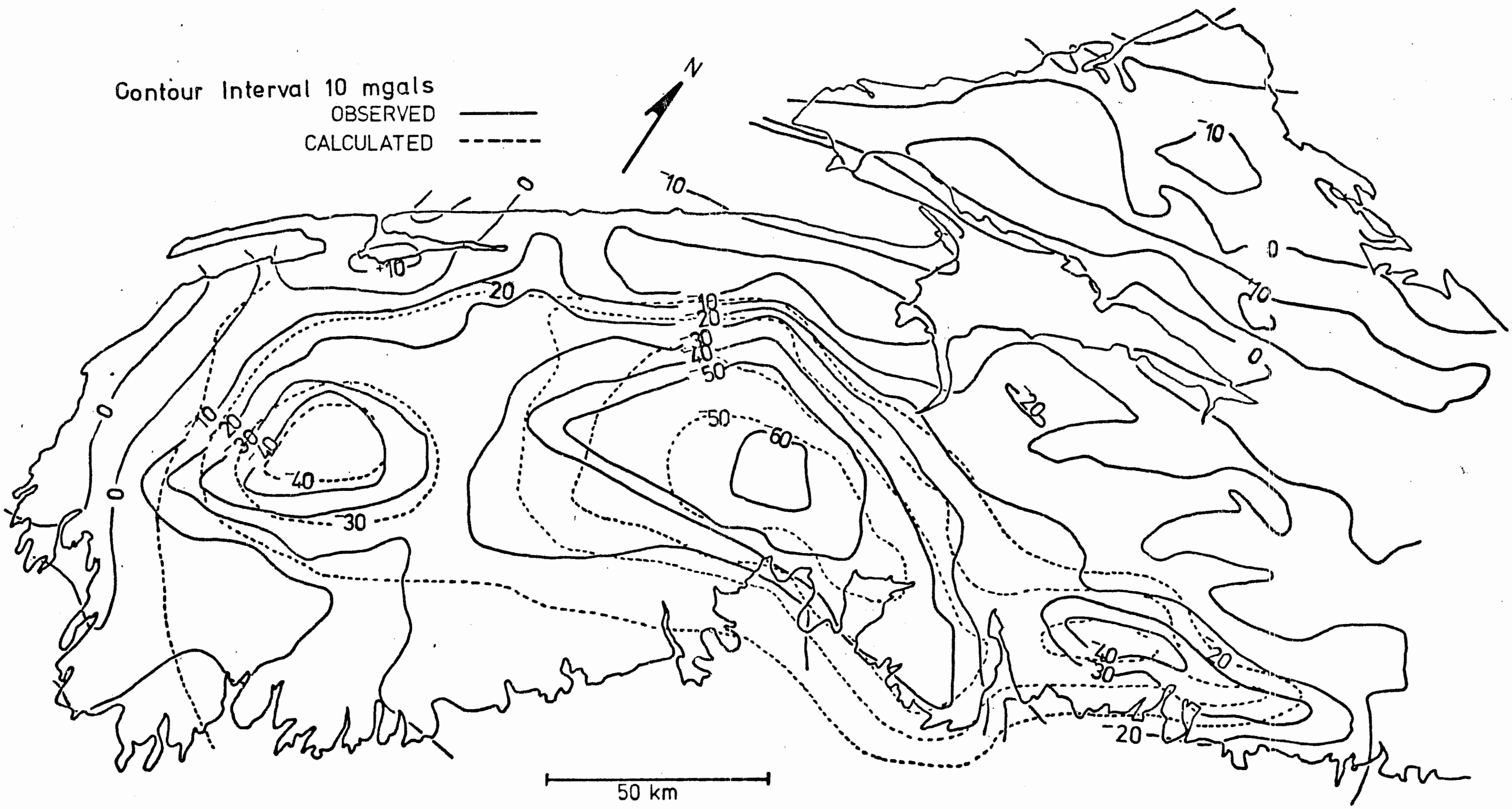

N
A
CC
B
BB
C
AA
OBSERVED and MODELLED
GEOLOGY
ADAMELLITE
GRANODIORITE
BASALT

FIG. 8

computer store the output on tape and contour it.

The resulting gravity anomaly map is compared to the map of observed gravity as determined by field measurements. (Figure 9). If areas on the model map show discrepancies between observed and model anomalies, one adjusts either the dimensions or the density contrast of the body or bodies responsible for its generation. Since insufficient data were available to allow much variation in the density, they were assumed fixed for a specific rock type. This permitted only the dimensions to be changed.



Measured and Modelled Gravity of the
South Mountain Batholith

FIG. 9

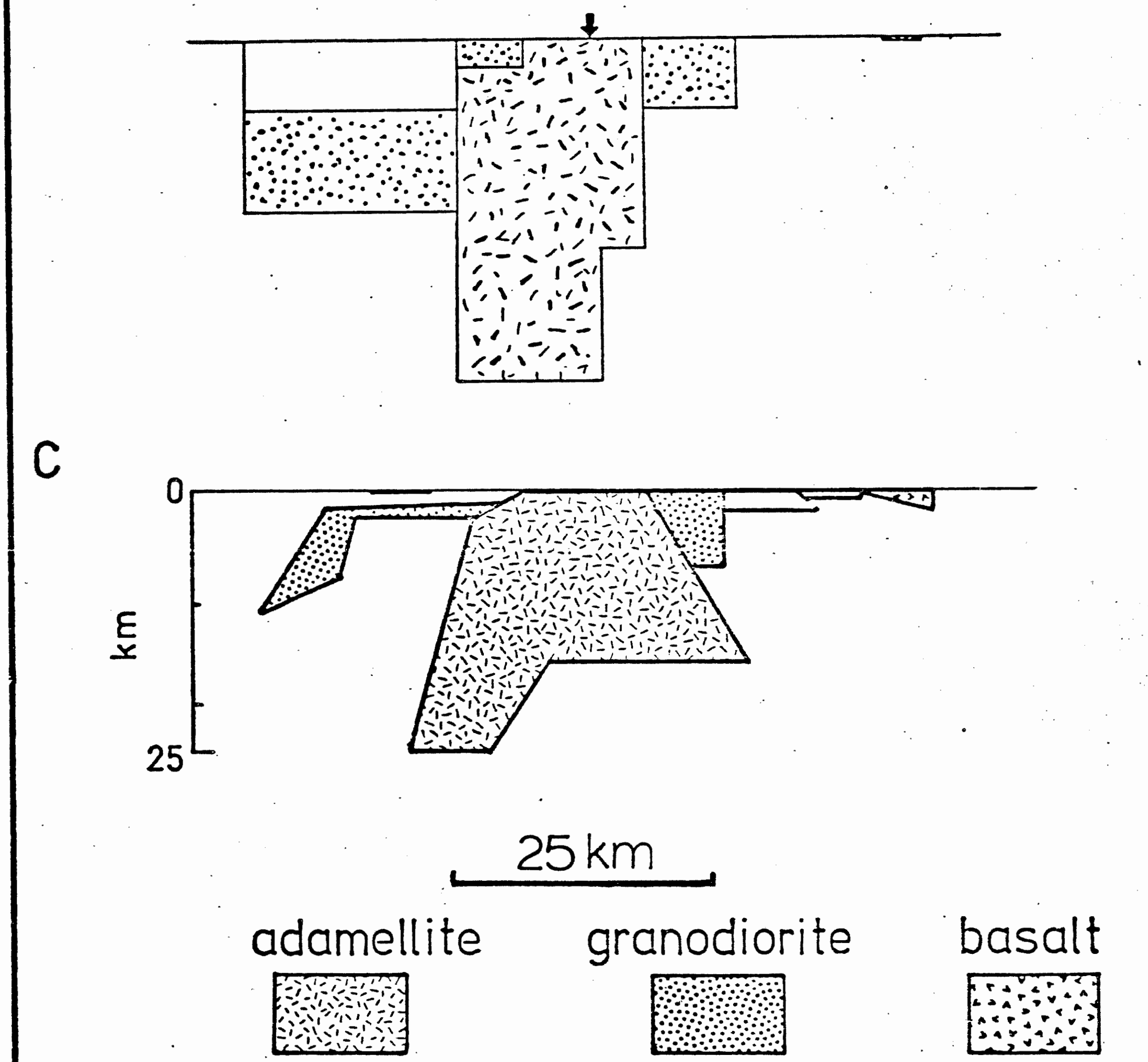
Summary of Two and Three Dimensional Models

Preliminary models were constructed and tested using the two dimensional technique. This allowed a rough model to be designed whose vertical dimensions were transferred to the three dimensional model. This eliminated much of the trial and error fitting that would have been necessary if the three dimensional model had been designed from scratch.

The two dimensional profiles, especially sections A - AA and B - BB, exhibited a marked lack of depth when compared to the three dimensional model. This discrepancy is resolved by noting that these sections are sub-parallel to the long axis of the batholith. Since the two dimensional program assumes an infinite prism and not the 60 kilometer width that the batholith has, the program calculates too great a mass deficiency and therefore generates a negative anomaly more intense than the observed anomaly. To make the anomalies match, it is necessary to construct a shallower body than actually exists.

Comparing the two dimensional profile C - CC with its three dimensional expression (figure 10), one sees that this effect is minimized, since this profile is nearly normal to the axis of the batholith, and the "infinite" dimension proviso is nearly satisfied.

The simplified geometry of the South Mountain Batholith is illustrated in figure 11. The maximum thickness of granitic material occurs at New Ross. The value of 25 kilometers is, in fact, a minimum, as it assumes that the



COMPARISON OF TWO AND THREE DIMENSIONAL MODELS ALONG LINE C-CC

FIG.10

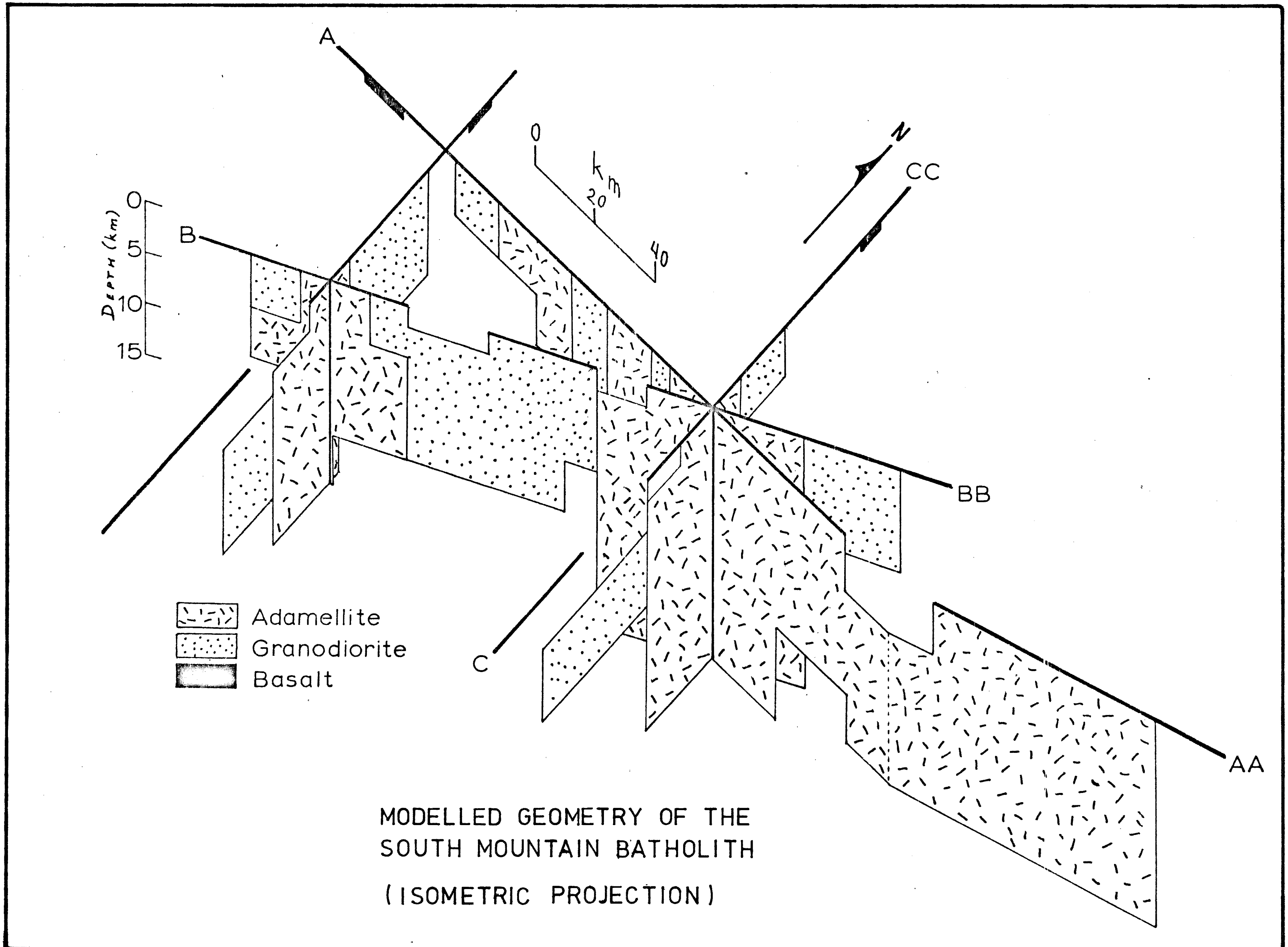

A
B
C
AA
BB
CC
N
0
km
20
40
DEPTH (km)
0
5
10
15
Adamellite
Granodiorite
Basalt
MODELLED GEOMETRY OF THE
SOUTH MOUNTAIN BATHOLITH
(ISOMETRIC PROJECTION)

FIG. 11

Two dimensional modelling indicates that if the adamellite of the New Ross-Vaughan complex continued to a depth of only 5 kilometers, the remaining granodiorite would have to extend to a depth of about 40 kilometers. While this approach may satisfy McKenzie's (1974) model of intrusive events, it is inconsistent with seismic data which limit the crust to about 35 kilometers. The batholith's true geometry may exist between the extremes of 25 kilometers and 40 kilometers, since by increasing the thickness of an adamellite slab, a proportionate decrease in granodiorite thickness occurs, until the minimum of 25 kilometers of adamellite is reached.

Clarke (personal communication, 1978) suggested that the lopsided gravity anomaly over New Ross might be due, in part, to a significant volume of pegmatite and greisen. The quartz and muscovite of the greisen have dnesities of 2,65 and 2.85 grams/cubic centimeter, respectively. There is no composition which could yield an average density of less than 2.63 grams/cubic centimeter, that of adamellite. To have any effect on the gravity expression, the greisen would have to be situated between the -40 and -50 milligal contours in the eastern part of the New Ross-Vaughan complex. This is due to mass excess that would be provided by the greisen offsetting some of the mass deficiency of the adamellite.

Pegmatite, in addition to quartz and muscovite, contains a significant amount of potassium feldspar, (S. G. 2.56 grams/cubic centimeter) and also biotite (S. G. 3.10 grams/cubic centimeter). This could result in rock with a density below 2.63 grams/cubic centimeter but since the pegmatite is limited in extent, (McKenzie, 1974; Taylor, 1969) it is unlikely to have contributed significantly to the anomaly generated by the adamellite, either in a positive or negative way.

Since the peripheral areas of the batholith have been mapped as granodiorite, the density contrast decreases from Garland's -0.10 grams/cubic centimeter value, to -0.05 grams/cubic centimeter. This necessitates an increase in sheet thickness from an average of 5 kilometers to approximately 10 kilometers. The portion of the betholith between the Kejimkujik and New Ross-Vaughan bodies increases to about 15 kilometers.

Three dimensional modelling suggests that several of the adamellite bodies are interconnected at depth. While the Musquodoboit Batholith is almost certainly connected to the New Ross-Vaughan complex, (MacKenzie, 1976) no evidence exists to demonstrate that the Kejimkujik adamellite is similarly connected.

Mineralization

Mineralization is confined primarily to the New Ross-Vaughan complex. It consists of tin, tungsten or molybdenum in pegmatite veins. The pegmatite represents what was probably the last phase of igneous activity within the batholith. The more acutely terminated roof of the proposed Kejimkujik adamellite could have confined mineralization to a smaller volume than occurs at New Ross.

The lack of mineralization in the smaller adamellite pods may be caused by any one or a combination of the following:

1) Smaller bodies possessed insufficient volume to crystallize incompatibles and volatiles at a late stage.
2) Rapid cooling history at the periphery of the batholith prevents concentration of incompatible and hydrous phases.
3) Migration of the bodies away from the New Ross-Vaughan complex, while still primitive and lacking in compatible phases.
4) Backward migration of volatiles and incompatibles along conduits in response to cooling of the peripheral pods - This might also result in a finite, as opposed to relative, increase in the concentration of these phases within the New Ross-Vaughan complex.
5) Mineralization was removed as the batholith was unroofed by erosion.

Conclusions

The results of this study show that sufficient evidence exists to update O'Reilly's model of the South Mountain Batholith. The granite lithologies have been successfully duplicated by computer modelling, and the results indicate that the intrusion is at least 25 kilometers thick at its thickest point. This assumes that the adamellite body at New Ross extends homogeneously to the floor of the batholith. The negative anomaly of 40 milligals in the Kejimkujik area, indicates a second major adamellite body within the South Mountain Batholith proper.

The interconnection at depth of some of the adamellite bodies, and the depth of the New Ross-Vaughan complex, conflict somewhat with McKenzie's (1974) proposed method and sequence of emplacement.

The lack of a granodiorite envelope around the Musquodoboit Batholith is somewhat anomalous. Further work is required before speculation concerning its position in the intrusive sequence of the South Mountain Batholith is justified.

Mineralization known to occur in the New Ross area, may also exist in the proposed Kejimkujik adamellite. Since outcrop is very limited, indirect means such as geophysics and geochemistry must be employed to determine any such occurrence.

References

Buddington,A.F.(1959); Granite emplacement with special reference to North America; Geol. Soc. America Bull. v.70, pp. 671-784.

Clarke,D.B. and Halliday,A.N.(1978): Strontium isotope work on the South Mountain Batholith,Nova Scotia; paper presented to the biennial symposium of the Atlantic Geoscience Society.

Dainty,A.M.,Keen,C.E.,Keen,M.J. and Blanchard,J.M.(1966): Review of geophysical evidence on crust and upper-mantle structure on the Eastern Seaboard of Canada; in The Earth Beneath the Continents, edited by Steinhart,J.S. and Smith,T.J., Geophys. Monogr., no.10,pp.349-369.

Garland,G.D.(1953): Gravity measurements in the Maritime Provinces; Publications of the Dominion Obs., v.16, copy 2, Dept. of Mines and Technical Surveys, pp.185-275.

Jones,B.E. and MacMichael,T.P.(1976): Observations on the geology of a portion of the Musquodoboit Harbour Batholith; N.S.Dept. of Mines, Mineral Resources Division, Report of Activities-1975, pp. 63-71.

MacKenzie,B.(1976): Gravitational interpretation and modelling of the Meguma and intrusive granite in the Halifax area; B.Sc. Honours Thesis, Dalhousie University.

McKenzie,C.B.(1974): Petrology of the South Mountain Batholith,Western Nova Scotia; M.Sc. Thesis, Dalhousie University.

Nagy,D.(1964): The gravitational attraction of a Right rectangular prism;Contr. Dom. Obs.,v.6,no.12.

Neilsen,E.(1976): The composition and origin of Wisconsinan till in mainland Nova Scotia; Ph.D. Thesis. Dalhousie University.

Neilson,D.L.,Clark,R.G.,Lyons,J.B.,England,E.J. and Borns,D.J.(1976): Gravity models and mode of emplacement of the New Hampshire Plutonic Series, in Studies In New England Geology (Wolfe Volume), edited by Lyons,P.C. and Brownlow,A.H.,Geol. Soc. America, Mem.146, pp 301-318.

O'Reilly,C.T.(1975): Gravitational interpretation and modelling of the South Mountain Batholith, utilizing two and three dimensional computer programming; B.Sc. Honours Thesis,Dalhousie University.

Smitheringale,W.G.(1973):Geology of parts of Digby, Bridgetown and Gaspereau Lake Map Areas,Nova Scotia; Geol.Surv.Can.,Mem.375.

Talwani,M.,Worzel,J.L.,Landisman,M.(1959): Rapid gravity computations for two dimensional bodies with application to the Mendicino Submarine Fracture Zone; Jour.Geophys.Res.,v.64,no.1.pp.49-59.

Taylor,F.C.(1967): Reconnaissance geology of Shelburne Map Area,Queens,Shelburne and Yarmouth Counties, Nova Scotia;Geol.Surv.Can.,Mem.349.

——————— (1969): Geology of the Annapolis-St.Marys Bay Map Area, Nova Scotia; Geol. Surv.Can.,Mem.358.

Unpublished Data (1976): Gravity Division, Earth Physics Branch, Dept. of Energy Mines and Resources.

Appendix I

Density Determinations

Samples were cleaned and dry weighed on an Ohaus triple beam balance. After soaking in water overnight the samples were reweighed while immersed in distilled water. The difference in weight divided into the dry weight yields the specific gravity. The temperature of the water was recorded and corrections for the density of water were applied. In most cases the correction proved to be negligible. Specific gravity of the sample, multiplied by the density of the distilled water yields the density of the sample.

Table I-1 records the measured densities of adamellite, granodiorite and Meguma metasediment samples, and compares them with density determinations from O'Reilly (1975).

Table I-1

Adamellite Densities

Sample	Density(g/cc)	Sample	Density(g/cc)
2037	2.64	16941	2.61
2038	2.63	16846	2.66
2041	2.66	17348	2.54
2042	2.61	17349	2.58
2069	2.63	17217	2.68
2076	2.63	17084	2.56
2077	2.65	16415	2.64
2078	2.63	16789	2.57
2079	2.65	17107	2.70
2083	2.66	17388	2.60
2084	2.65		

Number of Samples = 21
Mean Density = 2.63
Standard Deviation = 0.04 O'Reilly's Mean =2.63

Granodiorite Densities

Sample	Density(g/cc)	Sample	Density(g/cc)
16938	2.67	16924	2.67
16923	2.68	16462	2.61
16407	2.66	17081	2.72
16587	2.74	17800	2.62
16933	2.69	17373	2.71

Number of Samples = 10
Mean Density = 2.68
Standard Deviation = 0.04 O'Reilly's Mean =2.68

Metasediment Densities

Halifax Formation (Slates)

Sample	Density(g/cc)	Sample	Density(g/cc)
17394	2.74	16446	2.73
16481	2.47	17103	2.95
17393	2.68	17395	2.80
17020	2.61	16457	2.81
17396	2.93	16318	2.66
17009	2.61	16183	2.88
16363	2.82	17443	2.92
17120	2.78	17402	2.77
16279	2.69		

Number of Samples = 17
Mean Density = 2.76
Standard Deviation = 0.13

Goldenville Formation(Quartzites)

Sample	Density(g/cc)	Sample	Density(g/cc)
17180	2.69	16408	2.72
17113	2.74	17179	2.70
17127	2.71	17361	2.72
16834	2.74	16451	2.63
16814	2.67	17178	2.61
16404	2.71	16495	2.61
16384	2.70		

Number of samples = 13
Mean Density = 2.69
Standard Deviation = 0.05

Mean of the Mean Metasediment Densities= 2.73 g/cc

O'Reilly's Mean Metasediment Density = 2.73 g/cc