A GEOPHYSICAL STUDY OF THE
BAY OF FUNDY AND
GULF OF MAINE

by

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ABSTRACT

Recent marine geophysical surveys in the Bay of Fundy and Gulf of Maine are used to extend the lithology and structure observed on the nearby shore to the offshore regions of Nova Scotia. A difference in tectonic styles can be seen on opposite sides of the Glooscap fault system. This may be correlated with the termination of the Meguma platform of Nova Scotia. Geologic models are proposed; and the structures tested by computer modelling of the gravity data.

Résumé

Des relevés géophysiques marins récemment acquis dans la Baie de Fundy et le Golfe du Maine sont utilisés pour étendre aux régions au large de la Nouvelle-Ecosse la lithologie et la structure observées sur les côtes adjacentes. Une différence de style tectonique est reconnue de l'autre côté de la faille Glooscap. Ceci peut être relié avec la fin de la plate-forme Meguma de la Nouvelle-Ecosse. Des modèles géologiques sont avancés et les structures sont vérifiées par ordinateur contre le modele basé sur les données de gravité.

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Chapter 1. Introduction and Purpose

1.1 Purpose of investigation

During recent years numerous hypotheses concerning the geological history of the Appalachians and the role of continental drift in the formation of Eastern Canada have been presented. Generally the water covered regions of the Bay of Fundy and the Gulf of Maine have been a major stumbling block due to the unknown nature of the lithology and structure of these submerged areas. Geology relatively easily observable on land, is obscured by water depths of up to 300 meters and a widespread blanket of recent sediment, making observation of bedrock difficult, even with the use of submersible vehicles.

The Bay of Fundy has been receiving attention from geologists for the last century. It is a funnel-like body of water separating Nova Scotia from New Brunswick, located along the axis of a broad syncline known as the Acadian, or Maritime Triassic Basin. The Bay has frequently been considered as a possible source of hydroelectric power because of its unusually high tidal variations.

As early as 1897 there was a dispute as to the role of the Bay of Fundy in the geological history of North America, when Prof. L.W. Baily (1897) delivered a speech to the Royal Society of Canada, showing discrepancies between the theory presented by Dana (1895) of the geological history of the Appalachians, and field data from Nova Scotia and New Brunswick. Baily showed proof of the existence of terrestrial areas, in the vicinity of the Bay of Fundy trough, at the beginning of the Cambrian era and concluded that the Bay was a geosyncline subsiding since Precambrian time, which progressed through geosynclinal deposition and uplift during the Paleozoic. He stated that the Bay received alternating continental and shallow marine deposits during the Carboniferous era, and finally shallow marine deposits in a Triassic fault basin.

Further dispute followed, in 1925, with the publication of the book 'New England and Acadian Shorelines' by D.W. Johnson (1925), in which he extended the Triassic strata of the Bay of Fundy into the Gulf of Maine and presented the idea of a 'Fundian Fault'. The fault, proposed on the basis of lead line depth soundings that showed the presence of a linear scarp running parallel to the coast of Maine near Great Wass Island, was suggested to be the location of the northern boundary of the Triassic sediments found in the Bay of Fundy. The depth soundings also showed the presence of a smooth plain extending from the mouth of the Bay into the Gulf, which was interpreted as an extension of the 'gently undulating floor of the submerged Triassic lowland'. Shepard (1930) challenged Johnson's interpretation of the 'Fundian Fault' and claimed that the scarps were caused by glacial erosion.

More recent studies of the area by geophysical methods (Swift and Lyall (1968); Uchupi (1966); King and MacLean (1976)) have provided data that are used to extend known geology offshore and produce an interpretation of the subsurface structure. Hopefully this knowledge may give some insight into the formation of the Bay of Fundy and resolve some of the still unanswered questions about the overall geology of the area.

Knowledge of the lithology and structure of the Bay of Fundy - Gulf of Maine region is essential to understanding the geology of northeastern North America. Interest has recently been focused on geophysical methods as a means of answering some of the questions left unresolved by simple extrapolations of onshore geology to water covered areas. Geophysical data suitable for an interpretation of the regional geology of these areas have been compiled by Canadian and American oceanographic institutions.

Geophysical data collected in the eastern portion of the Gulf of Maine and in the Bay of Fundy by the Bedford Institute of Oceanography (BIO), of the Department of Energy, Mines and Resources have been made available to the author for the purpose of determining the overall geological setting of the area and its relationship to the regional geology of the surrounding regions. With these data it is hoped that information about the lithology and structure may be used to provide further insight into its evolution. Interpretation of these field data will be compared with results obtained by computer modelling of a theoretical structure.

1.2 General Description of the Study Area

The Bay of Fundy, a northeast trending trough separating Nova Scotia from New Brunswick, is well known for its tidal fluctuations, which in places exceed 17 meters. Located along the axis of a broad southwest dipping syncline, known as the Maritime Triassic Basin, it is approximately 170 km long and varies in width from 75 km at the mouth to 50 km at the head of the Bay (Fig. 1).

In general the bathymetry can be related to the geology of the floor of the bay. Triassic sediments are the major component of this floor and have been uniformly eroded by glacial, fluvial and marine action. Any sudden change in the bathymetry can usually be related to a change in geology. A bathymetry high can be traced from near Cape Chegnecto beyond

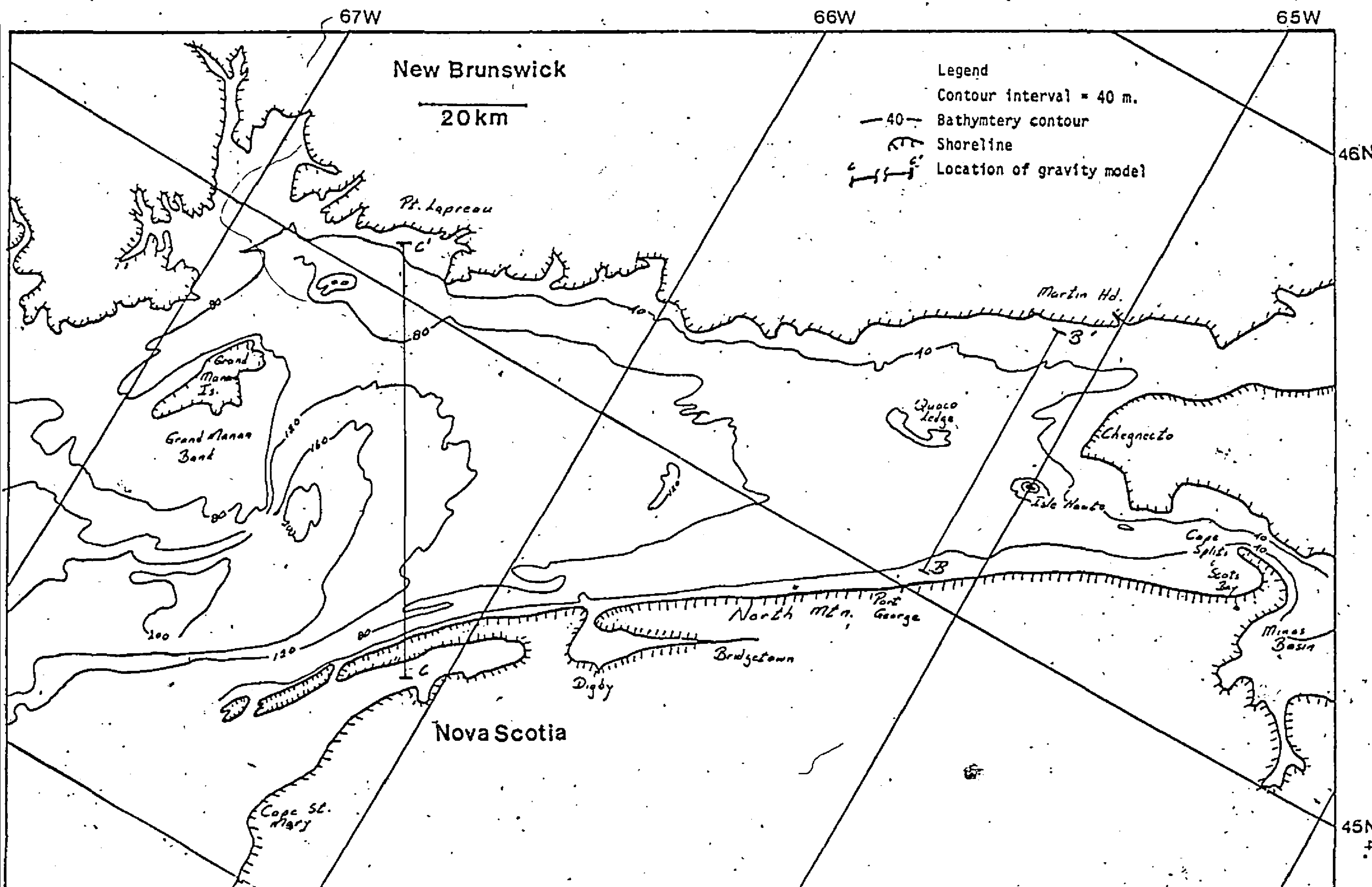

Fig. 1 Bay of Fundy showing bathymetry and location of gravity models

Île Haute to Quaco Ledge (45°15N, 65°25W), which is exposed at low tide. Samples collected from the outcrop by the author were identified as Triassic basalt, as opposed to the Triassic sediments that are usually found across much of the Bay (see Fig. 2).

Near Grand Manan Island the smooth floor of the Bay is broken by outcrops of rocks that constitute pre-Pennsylvanian acoustic basement (Fig. 2). The contacts with the Triassic are readily identified by the abrupt changes in the bathymetry. The surface of the older rock is very irregular and the water depth is much less than that observed over the Triassic deposits.

The Bay of Fundy opens into the Gulf of Maine, a more or less rectangular body of water approximately 365 km by 250 km bounded on three sides by Appalachian geology. The bathymetry of the Gulf is more complex than that observed in the Bay of Fundy and attempts to correlate topography and structure are not usually successful.

This study will be concerned with the Bay of Fundy and that portion of the Gulf of Maine bounded by 68°W and Brown's Bank (approx. 66°W, 43°N). The section west of 68°W has been studied by Kane (1970) and Kane <u>et al</u>. (1972). References to that area will be based mainly upon these works.

1.3 Previous Investigations

Studies of the structure and lithology of the Bay of Fundy-Gulf of Maine area have been carried out in two phases. During the first phase workers used dredged samples and depth measurements, taken largely with lead lines, to speculate about the nature of the bottom. These early surveys were surprisingly accurate considering the somewhat scanty data which were available to the interpreters.

The second phase began with the report of Drake et al (1954) which described the results of seismic refraction lines shot in the Gulf of Maine. This marked the first use of geophysical methods to interpret the lithology and structure of the Gulf. Since then the area has been surveyed to obtain magnetic, gravity and seismic reflection data and some interpretation of the geology made.

Published literature on the Gulf of Maine has been reviewed by Uchupi (1966), Kane (1970), Kane et al (1972) and Emery et al (1970). A brief description of the conclusions based on these reviews follows.

Uchupi (1966) reported on seismic reflection data obtained in the Gulf and summarized the results of the earlier phase of exploration. This paper will be discussed first since it reviewed all previous work and gave the first comprehensive analysis of the structure of the Gulf. Based on his own work and on previous studies, Uchupi reported the following. Strata of Triassic age extend from the mouth of the Bay of Fundy 120 km southwest into the Gulf to form three narrow troughs. Cretaceous rocks are present in Georges Basin and possibly as an erosional remnant in Cape Cod Bay. Rocks of Tertiary age are present as a continuous mantle in Cape Cod Bay and are also found on Georges Bank. The Gulf of Maine is erosional in nature and probably was formed during two erosional cycles, a fluvial cycle followed by glacial action. The acoustic basement seems to be quite near the surface in most areas and surficial cover rarely exceeds 300 meters. It is characterized by a very irregular surface and probably consists of Paleozoic intrusions and metamorphic and Jurassic igneous rocks.

Drake et al (1954) used seismic refraction data to show that the Gulf is underlain by a discontinuity quite near the surface. Below this the seismic velocity was a fairly uniform 6.1 km/sec, which they concluded

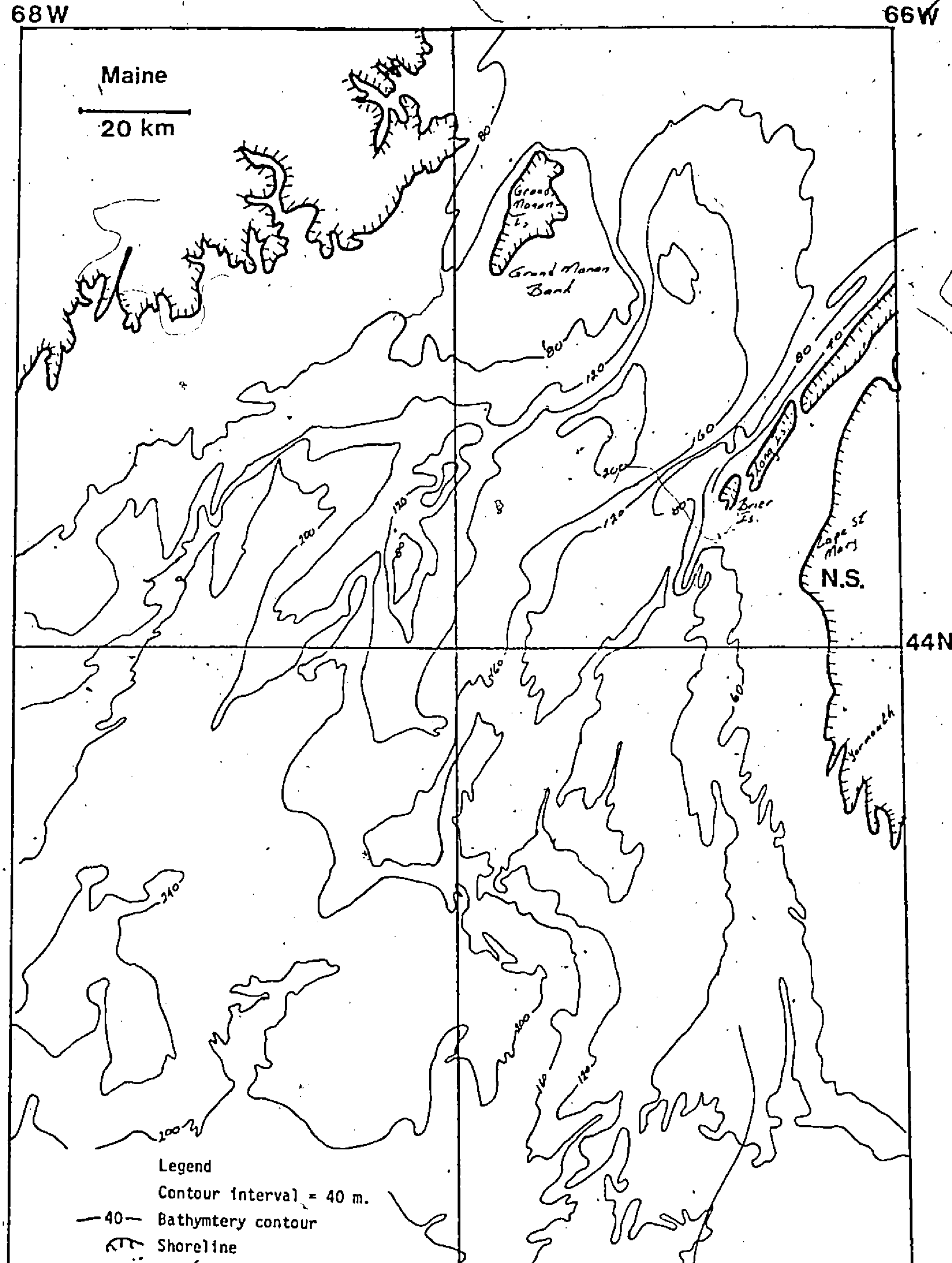

Fig. 2 Bathymetry of northeastern Gulf of Maine

was due to a 'sub-basement' horizon. Near Yarmouth, Nova Scotia, a depression was found filled with 3000 m of strata in which the P-wave velocity was 5.1 km/sec. Near Cashes Ledge localized deposits with a P-wave velocity of 4.0 km/sec were interpreted as being of probable Triassic age. Uchupi (1966) later disputed this interpretation and suggested the occurrence of mildy metamorphosed rocks of Paleozoic age. The seismic lines used by Drake et al (1954) had large separations between the shot point and the receiver locations. The data will therefore give an oversimplified picture of the structure and a loss of resolution for the near surface velocities; it will, however, give a better determination of the velocities in the lower layers, making it possible to search for discontinuities at depth.

Worzel and Schubert (1955) concluded that the Gulf of Maine was a flooded continental block, based on submarine gravity readings that showed the gravity field in the Gulf was approximately 20 milligals (mgal) higher than that observed over the surrounding land areas.

Steinhart et al (1962) analyzed a seismic refraction profile from the centre of the Gulf of Maine to the interior of Maine and showed that seismic models, with either sharp or transitional changes in velocity between the upper and lower layers and between the crust-mantle interface, would satisfy the data.

Bower (1962) reported on a ship-magnetometer survey of the western Gulf and suggested that the strong linear trends in the magnetic field off Yarmouth may be due to extensions of the volcanic rocks found near Yarmouth, which showed similar magnetic characteristics.

Malloy and Harbison (1966) reported on detailed magnetic and seismic reflection measurements made over the northeastern Gulf of Maine. They delineated several linear fault zones and contacts between the Triassic strata and the tightly folded crystalline Paleozoics, which they believed to occur along faults that had been intruded by dykes. A ring-dyke was also identified on the basis of the similarity of the magnetic data to that observed over a known occurrence of a ring-dyke.

Schlee and Pratt (1970) concluded that the gross bedrock geology could be identified from pebbles obtained in dredge hauls from the Gulf and reported the following concerning the eastern portion of the Gulf. Sediments similar to those of Triassic age extend from the Bay of Fundy to Mount Desert Island. Spotted schist is present in the region offshore from Yarmouth, which may correlate with rocks of Ordovician age in Nova Scotia. Felsite occurs west of Yarmouth and extends to St. Mary's Bay.

Kane (1970) and Kane et al (1972) studied the gravity and magnetic fields over the Gulf of Maine and concluded that the bedrock contained abundant mafic rocks probably of early Paleozoic or Precambrian age and that major faults are present along at least some of the margins of the Gulf. The crust under the Gulf appears to be different from that of the surrounding area, but it does not clearly resemble any of the known conventional models of the crust.

Watts (1974) reported on a negative Bouguer gravity anomaly near Cape Sable, N.S., which he suggested may represent an extension of the granite that causes the negative gravity field over most of Nova Scotia. Models calculated on the basis of the gravity data were used to reinforce this hypothesis.

The Bay of Fundy has been covered by an aeromagnetic survey (Geological Survey of Canada maps #7036G, #7037G, #7032G, #7033G), which is the main source of magnetic data for the interpretation of the area.

Tagg and Uchupi (1966) interpreted seismic reflection data from the mouth of the Bay of Fundy which enabled them to extend the Triassic strata found in Fundy 120 km into the Gulf in three fingerlike troughs.

Swift and Lyall (1968a, 1968b) reported on seismic reflection data collected in the Bay of Fundy which allowed them to show that the structural and topographic axes of the Bay were offset. Profiles run near the supposed location of the Fundian Fault of Shepard (1930) failed to show any structures that would prove its existence at the mouth of the Bay, but did show a steep normal fault along the New Brunswick shore at the head of the Bay.

King and MacLean (1976) have produced a map of the regional geology of the area, which combines the results of other investigators and conclusions based on their own work at Bedford Institute of Oceanography, (BIO), Dartmouth, N.S.

Chapter 2. Geology and Geophysics

2.1 Introduction

The Appalachian range is a chain of relatively low, steep mountains that extends over 3000 km along the east coast of North America from Newfoundland to Alabama. The chain exhibits an overall northeast trend, which is prevalent both in the distribution of rock types and the strike of the major folds. The northern Appalachians, which surround the study area of the Bay of Fundy and the Gulf of Maine region, are a belt that was involved in the Tactonic (Middle to Late Ordovician) and the Acadian (Middle Devonian) orogenies. Most of the strata in the belt are of Early to Middle Paleozoic age and have been folded and regionally metamorphosed by these two orogenies. Rocks of Precambrian age form the cores of the structural uplifts to the west and are exposed in widely separated areas in the eastern portion of the belt. Carboniferous sediments were deposited in narrow intermontane troughs along the Fundy Geosyncline as a result of Middle and Late Paleozoic rifting and faulting. A re-activation of faulting resulted in Triassic sediments being deposited along the Bay of Fundy and in Chedabucto Bay.

A brief description of the regional geology and tectonics of the area surrounding the Bay of Fundy and Gulf of Maine is given to familiarize the reader with the study area. A more detailed account of the geological history of the area may be found in Poole (1967), from which this precis is largely taken.

2.2 Geology of the Bay of Fundy and Gulf of Maine

The geology of the area surrounding the Bay of Fundy and the Gulf of Maine has been controlled by two main orogenitic events; the Taconian and the Acadian orogenies.

During the Late Proterozoic the area now occupied by the Bay of Fundy appears to have been a portion of the Avalon Geosyncline, which by Late Hadrynian (latest Proterozoic) had evolved into the Avalon Platform, upon which platform-type deposits of Late Hadrynian and Paleozoic age accumulated (Fig. 3). Remnants of these deposits are still present in Cape Breton and along the north shore of the Bay of Fundy, while Precambrian deposits near Cape Cod, Mass., may also be part of the same sequence.

During the Cambrian and Early Ordovician eras, sediments were deposited in the widely separated belts of the Meguma and Acadian Geosynclines and on the St. Lawrence and Avalon Platforms (Fig. 3). Sedimentation continued uninterrupted until the start of the Taconian Orogeny in the Middle Ordovician. The St. Lawrence and Avalon Platforms were uplifted and deposition ceased. In the Meguma Geosyncline up to 9500 m (30,000 ft.) of sediments were deposited. The lower unit of the group, the Goldenville Formation, consists of 6000 m or more of greywacke and slate, showing evidence of northeast to east flowing turbidity currents aligned parallel to Devonian fold trends. The upper unit, the Halifax Formation, consists of 500 to 4000 m of dark slate and siltstone. The early phases of the Taconian Orogeny produced epeiorogenic movements on the St. Lawrence Platform and Avalon Platform but had no effect on the neighbouring geosynclines.

The Middle and Late Ordovician were tectonically active periods within the Appalachian Geosyncline. In the Acadian Geosyncline deposition of greywacke-volcanics appears to have continued until Middle Ordovician, while in the Meguma Geosyncline deposition changed from the grey shale of the Early Ordovician to the volcanics, quartz sand and shale of the White

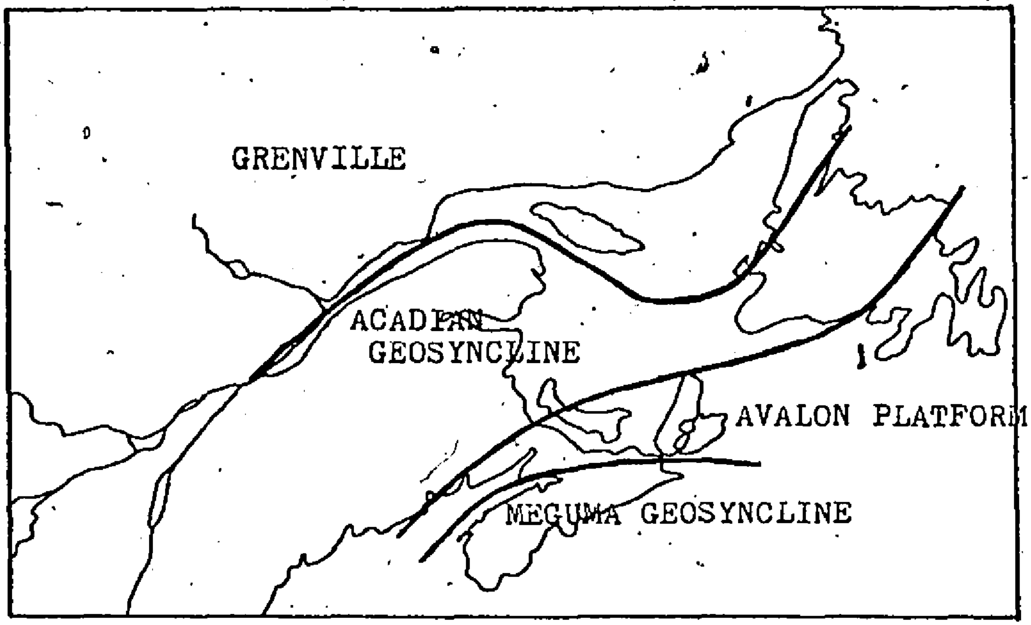

Fig. 3 Latest Hadrynian, Cambrian and Lower Ordovician Depositions

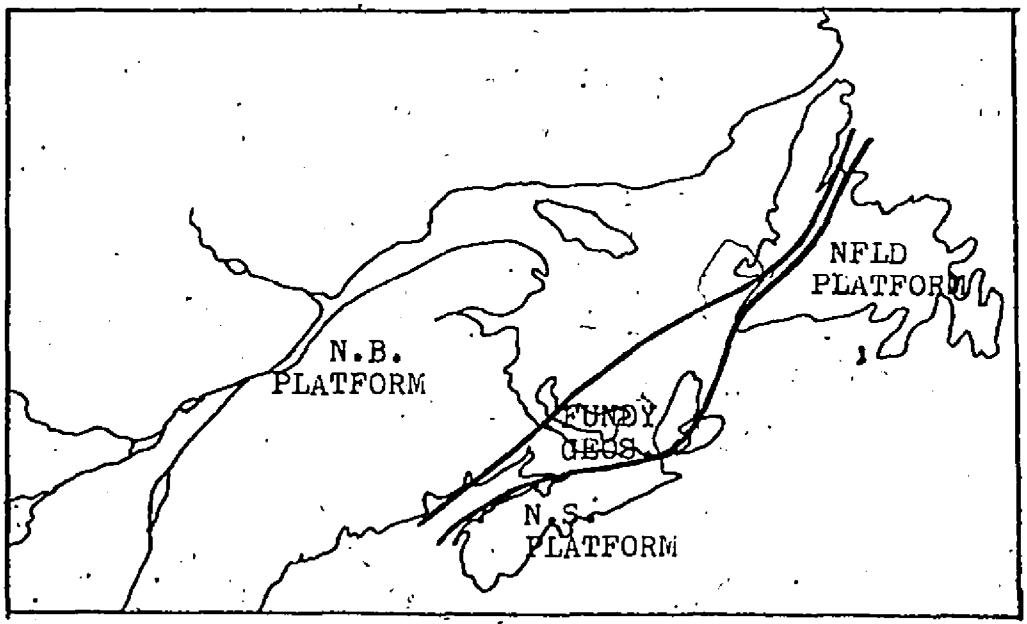

Fig. 4 Upper Devonian and Lower Mississippian Depositions

Rock Formation. It was postulated that during mid-Middle Ordovician the Avalon Platform in New Brunswick and Cape Breton Island was folded, intruded by mixed granitic rocks and uplifted.

Beginning in early-Middle Silurian, deposition of the White Rock and a somewhat similar Kentville Formation sedimentation appears to have continued in the Meguma Geosyncline during the Silurian and Early Devonian, while the Arisaig Group was deposited on the Avalon Platform in N.B., and Cape Breton Island.

The Middle and Late Devonian saw the start of the Acadian Orogeny, which converted the Appalachian Geosyncline into a stable craton (Fig. 4), which was then deformed by faults, warps and gentle basinal subsidence. In the Meguma Geosyncline deposition ceased in Middle or Early Devonian, while it continued to middle Early Devonian in the Acadian Geosyncline. On the Avalon Platform sandstone and siltstone were deposited on the Arisaig Formation. In the main phase of the Acadian Orogeny (late Middle to early Late Devonian) rocks of the Meguma and Acadian Geosynclines and the Avalon Platform were folded and faulted and parts were metamorphosed to schist and gneiss; there was considerable intrusion by granite batholiths and the entire area was uplifted and eroded (Fig. 5). The Acadian Orogeny decreased in intensity of tectonism from Late Devonian to Permian, by which time the principal features of the older tectonic elements no longer influenced sedimentation.

Ballard and Uchupi (1972) put forth the idea that the Bay of Fundy-Gulf of Maine areas owe their present form to two periods of rifting; the first between the Upper Devonian and mid-Pennsylvanian, the second in Late Triassic.

The first period of rifting, the Maritime Triassic Disturbance (Poole 1967), gave rise to the Carboniferous Fundy Rift Basin which may extend from the Scotian Shelf through Fundy and across the Gulf of Maine. Between 1500 and 3000 m of sediments were deposited during early Mississippian time in the fault controlled Fundy Rift Basin, while a thin layer of sediments was deposited on the adjacent stable New Brunswick and Meguma Platforms. The sediments in the Fundy Rift Basin were highly folded, faulted and mildy metamorphosed at the end of the initial rifting (Fig. 4).

The second stage of rifting began in the late Triassic and led to the development of the Maritime Triassic Basin of the Bay of Fundy, the borders of which often coincide with the shores of the Bay. The basin was the site of sedimentation and a zone of volcanic intrusions associated with post-depositional disturbances. The Maritime Triassic Basin seems to be a zone of block faulting and tensional movement related to the older Carboniferous rift system.

Triassic faults extend from the Bay of Fundy eastward to Chedabucto Bay and across the Scotian Shelf, causing development of a downfaulted and downwarped trough, in which fluviatile and lacustrine facies overlain by over 100 m of theorlitic basalt were deposited (Poole 1967).

The locus of the Triassic deposits coincides roughly with the zone of low grade metamorphic Carboniferous sediments and post-Carboniferous faults. The Triassic Basin has been flexed into a broad geosyncline defined by the curved cuesta of Cape Split (Fig. 1), plunging towards the Gulf of Maine, with dips of a few degrees. The trough is bounded on the north shore by a series of normal faults (south side down) while the strata on the south side rest unconformably on older rocks. The floor of the Bay, from Chegnecto

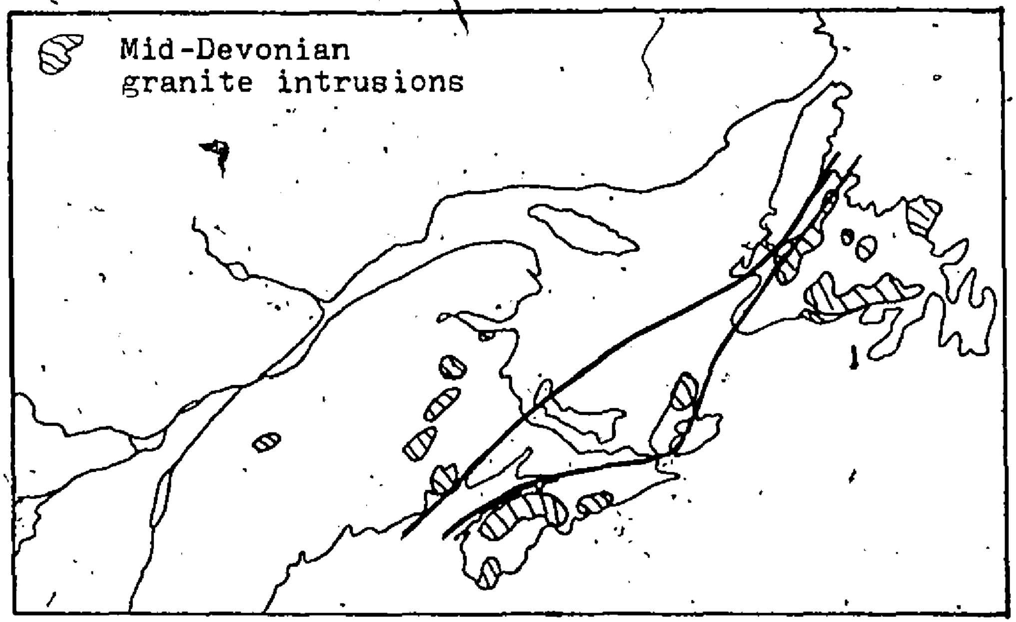

Fig. 5 Mid-Devonian Granite Intrusions

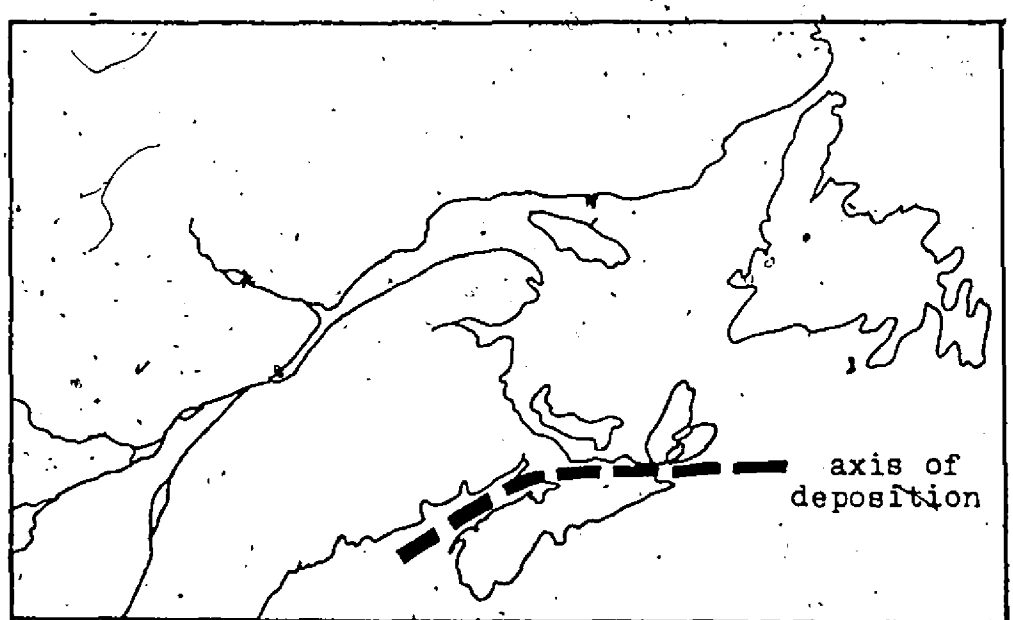

Fig. 6 Axis of deposition during the Upper Triassic Palisades Disturbance

Bay to Grand Manan (Fig. 1), is a smooth plain of Triassic rocks which generally have greater dip than do younger formations - an indication of tectonic activity after the Triassic beds were deposited.

Near Grand Manan the Triassic sediments are faulted into a number of basins, separated by basement highs of pre-Pennsylvanian rocks (Fig. 2). The Triassic sediments generally dip away from these basement highs.

The Palisades disturbance (Fig. 6), which led to the deposition of the Triassic deposits in the Bay of Fundy, appears to have been the last major tectonic event recognized in the Canadian Appalachians. Rocks of Jurassic age have not been recognized in the Bay of Fundy, but are known to occur on the Scotian Shelf and are thought to underlie part of the Gulf of Maine (King and MacLean, (1976)).

2.3 Correlation of Densities, Susceptibilities and Lithologies

When dealing with potential field data it must be realized that there are no unambiguous relationships between the physical properties of rocks and type of rock. However, some of these are well established and can be used fairly conclusively to determine and analyze specific lithologic units.

It has frequently been noticed when dealing with well consolidated rocks that gravity highs are produced by mafic or ultra-mafic rocks, while felsic intrusions produce gravity lows. Kane and Bromery (1968) showed that these relations are valid with respect to the gravity field and geology in Maine. In Nova Scotia and parts of New Brunswick, however, Garland (1953) has shown that some of the gravity lows found there are caused by low density sediments of Carboniferous and Triassic age. This will make the interpretation of gravity lows near Nova Scotia somewhat ambiguous, although the gravity highs seem to be caused unilaterally by mafic and ultra-mafic masses.

When analyzing aeromagnetic anomalies it is frequently assumed that the sources of the anomalies are primarily igneous rocks, either volcanic or plutonic. However, in Nova Scotia the main occurrence of igneous rocks is an essentially non-magnetic granite of Devonian age. As noticed in other areas, the granite has a magnetic aureole associated with it, due either to a differentiation of the granite or to metamorphism of the country rock. Igneous rocks of the White Rock and Kentville Formations and the Triassic North Mountain basalt all show relatively high magnetic anomalies and an anomaly of 300 to 400 nT (1 nanotesla = 1 gamma = 10^{-9} weber/m^2 = 1 nT), is associated with the Halifax formation, a metamorphosed unit of Ordovician age. Thus the magnetic anomalies in Nova Scotia can be attributed to at least two sources, igneous and metamorphic rocks. This will add ambiguity to the interpretation.

A brief description is given of the characteristics of the more important lithologic units, outlining the criterion used to identify the causes of the anomalies in water covered areas. These are summarized in Table 1.

The oldest rocks in the study area are the Precambrian rocks found on the north shore of the Bay of Fundy. These outcrops are generally characterized by positive Bouguer anomalies of up to 25 mgal, and a mild positive magnetic anomaly with short wavelength and an average amplitude in the range 0 to 200 nT.

Rocks of the Goldenville and Halifax Formations of the Meguma Series, are the oldest found in southwestern Nova Scotia. The Goldenville

TABLE 1

Potential Field Characteristics of the Major Lithologic Units in the Study Area.

UNIT	MAGNETIC ANOMALY	BOUGUER GRAVITY
Precambrian	0 to 200 nT	positive
Goldenville	below -200 nT	positive
Halifax	-200 to 0 nT	positive (but less than Goldenville)
Granite	below -200 nT	negative
Carboniferous	0 to 400 nT	negative
Triassic sediment	-100 to 0 nT	negative

Formation consists primarily of early Ordovician greywacke. Taylor (1967) reports approximately 5,600 m (18,500 ft) of these strata exposed between the base of the overlying Halifax Formation and the crest of an anticline 0.5 km northwest of Black Point, Nova Scotia (Fig. 2). Approximately 3200 m of Halifax Formation are exposed in a syncline near Cape St. Mary (Fig. 2), in the Goldenville. Since the effects of folding and faulting are not completely known, this value is only an estimate of the actual thickness of the strata.

A density of 2.7 to 2.75 gm/cm^3 has been suggested for the Meguma by Garland (1953) on the basis of scattered density samples. For this study a density of 2.8 gm/cm^3 has been chosen for the Goldenville Formation and of 2.70 gm/cm^3 for the Halifax, based mainly on the results of Garland (1953), and from recent density studies (unpublished, Goodacre (1973)). The density contrast of 0.15 gm/cm^3 between the Goldenville and the Devonian granite found in Nova Scotia (2.65 gm/cm^3) accounts for the steep gravity gradients observed at contacts of these rocks. The magnetic field observed over the Goldenville is usually quite uniform, although slightly higher than that observed over the exposures of granite in N.S. Near Yarmouth a zone of high magnetic readings occurs over rocks mapped as argillite (Taylor (1967)). The magnetic field associated with the Halifax Formation shows linear anomalies over portions of the formation and a rather uniform field over others. The magnetic field seems to be controlled somewhat by the structural relationships of the formation. A qualitative examination of the field over the Halifax Formation shows that a magnetic high generally occurs over areas that have been folded into synclines and a low over areas that have been folded into anticlines, (Geological Survey of Canada Maps #7030G and #7032G, Taylor (1967)). A possible explanation of this association is a zone of magnetic material near the base at the Halifax Formation. Where the zone occurred near the crest of an anticline the material has probably been removed by erosion, since it is at a higher elevation, more susceptible to erosion than similar material in synclines. Removal of the magnetic strata will cause the field to be lower over the crests of anticlines than over the synclines, where there is now more magnetic material. The outcrop of Halifax Formation near Cape St. Mary (Fig. 2) has a high magnetic anomaly associated with its central portion. Since the formation occurs in a plunging syncline at this location, the magnetic anomaly could be explained by a zone of magnetic strata near its base. Bower (1962) has suggested that the orientation of the rock may have an appreciable effect on the intensity of a magnetic anomaly. However, the magnetic depressions seen along the crests of anticlines in the Halifax Formation are a strong indication of erosional stripping of the magnetic material.

The White Rock formation of Ordovician and/or Silurian age partly overlies the Halifax Formation in western N.S. (Fig. 7). The complex lithology of this formation leads to a rather complex geophysical signature. An irregular series of magnetic highs is clearly outlined over the White Rock Formation, which Bower (1962) attributed to the volcanics in the area. In general the magnetic anomalies trend northeast for some distance and often can be extrapolated offshore.

One of the most noticeable features of Nova Scotian geology is a large granite batholith of Devonian age (Fig. 7). Garland (1953) noted a general coincidence of negative gravity anomalies with the large granitic masses of Nova Scotia and suggested that the granite was responsible, at least in part, for the low gravity field of Nova Scotia. A steep gradient in the gravity field is usually observed at contacts of the granite and the metamorphosed rocks of the Meguma Group. A density of 2.6 to 2.65 gm/cm^3 was suggested for the granite by Garland. For this study a density of 2.65 gm/cm^3 has been chosen. The magnetic field over the granite is characterized by its uniformity. A model study by Garland showed that the magnetic field of the granite was that of a uniformly magnetized body, with a susceptibility contrast of 0.0011 cgs units less than the surrounding slates and quartzites of the Meguma Group. Both the gravity and magnetic characteristics reflect a low magnetite and heavy accessory mineral content. A magnetic aureole is seen around the granite at contacts with the country rock.

Carboniferous sediments overlie the older formations in the middle portion of the province of Nova Scotia and in parts of New Brunswick and effectively mask the gravity and magnetic signals associated with the older rocks. In such areas a positive magnetic anomaly with long wavelength can usually be seen, accompanied by a negative gravity anomaly, whose amplitude

TERTIARY AND LATEST CRETACEOUS

T — BANQUEREAU FORMATION (s) (MAESTRICHTIAN-PLIOCENE)

CRETACEOUS

K — MISSISAUGA, NASKAPI, LOGAN CANYON, DAWSON CANYON, WYANDOT FORMATIONS (s) (Some formations are present on cross-sections only)

JURASSIC

J — ARGO, IROQUOIS, MOHAWK, ABENAKI, MIC MAC, VERRILL CANYON, MISSISAUGA FORMATIONS (s) (Some formations are present on cross-sections only)

TRIASSIC

Tr

Trs2 — SCOTS BAY FORMATION (s)

Trv

Trv2 — NORTH MOUNTAIN BASALT

Trs1 — WOLFVILLE, BLOMIDON FORMATIONS (s)

gabbro dyke

Trv1 — McKAY HEAD BASALT

PERMIAN

P — PICTOU GROUP (s) (Includes undifferentiated Pennsylvanian strata)

CARBONIFEROUS

PENNSYLVANIAN

P — RIVERSDALE, CUMBERLAND, PICTOU, PETITCODIAC, BARACHOIS GROUPS (s) (Includes undifferentiated Pennsylvanian and Upper Mississippian rocks in western Newfoundland, may include Permian rocks in the central part of the Laurentian Channel)

Pb — gabbro and associated rocks in northern Nova Scotia

MISSISSIPPIAN

M — HORTON, WINDSOR, CANSO, HOPEWELL, MISPEK, ANGUILLE, CODROY GROUPS (s,v) (Lower part of Horton group is late Devonian in age)

DEVONIAN

D — KNOYDART, TORBROOK, McADAM LAKE, FISSET BROOK FORMATIONS (s,ms,v)

Dg — granite (May include older granites)

SILURIAN AND DEVONIAN

SD — ARISAIG GROUP and equivalents, KNOYDART FORMATION and equivalents, MIDDLE RIVER GROUP (s, ms, v)

SILURIAN

S — WHITE ROCK, KENTVILLE, NEW CANAAN FORMATIONS, MASCARENE GROUP (s, ms, v)

ORDOVICIAN

O — BROWNS MOUNTAIN GROUP, MALIGNANT COVE, STEWART BROOK FORMATIONS (ms, v)

CAMBRIAN-ORDOVICIAN

MEGUMA GROUP

COH — HALIFAX FORMATION (ms)

COG — GOLDENVILLE FORMATION (ms)

CAMBRIAN

MacCODRUM, CANOE BROOK FORMATIONS, BOURINOT, KELVIN GLEN GROUPS, TROUT BROOK, MacMULLIN, MacLEAN BROOK, MacNEIL, McLEOD BROOK FORMATIONS, SAINT JOHN GROUP (s, ms, v) (Includes some Lower Ordovician strata)

PRECAMBRIAN

PC — GEORGE RIVER, FOURCHU GROUPS, MORRISON RIVER FORMATION, GREEN HEAD, COLDBROOK GROUPS AND RATCLIFFE BROOK, GLEN FALLS FORMATIONS (s, ms, m, v) (in New Brunswick, includes granite of probable later Precambrian, early Paleozoic age)

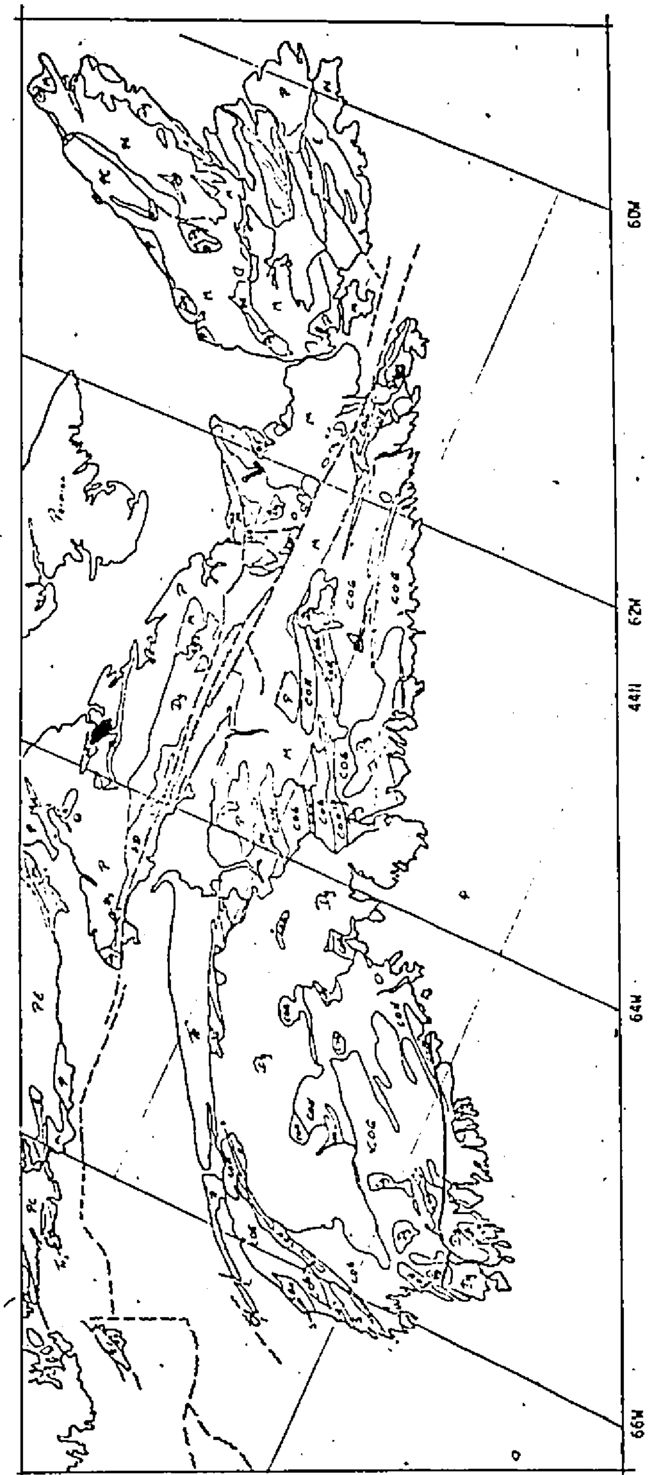

Fig.7 Geology of Nova Scotia, showing location of Glooscap Fault System

is dependent on the thickness of the Carboniferous strata.

The youngest rocks found in the study area are Triassic strata which occur along the shores and under the Bay of Fundy. These formations contain sedimentary and volcanic rocks. The sediments have long wavelength magnetic anomalies associated with them which are predominantly positive. The volcanic rocks have a pattern of short wavelength positive magnetic anomalies and have a much higher density than the sediments. The lower density of the sediments gives the Bay a negative gravity anomaly, which decreases towards the north. This decrease in the gravity field indicates a thickening of the low density sediments towards the north shore of the Bay.

Chapter 3. Source and Accuracy of Data

3.1 Source of data

The major portion of the data used in this study of the lithology and structure of the Bay of Fundy and Gulf of Maine was made available to the author by the Atlantic Geoscience Centre of the Bedford Institute of Oceanography (BIO), Dartmouth, Nova Scotia. BIO conducted surveys of the Bay of Fundy and Gulf of Maine areas during 1964 (cruise BAFFIN 64-019) and 1971 (cruise HUDSON 71-014) to collect geophysical data that could be used for an interpretation of the geology of offshore Nova Scotia. Further work was done in 1973 (cruise SACKVILLE 73-032) to help define suspected errors in the 1971 survey and to extend data coverage of the area.

During the first survey, magnetic and gravity data were collected near Grand Manan Island in the mouth of the Bay of Fundy (Fig. 2) on N-S lines spaced at approximately 0.8 km (0.5 miles).

This coverage was extended in 1971 (Watts and Haworth (1974)), when magnetic, gravity and reflection seismic data were collected on a series of east-west and northwest-southeast lines in the Gulf of Maine and on a single zig-zag line and several north-south lines in the Bay of Fundy.

Bottom gravity measurements were obtained in 1973 (Haworth (1973); Parrott (1974)) to check a series of discrete jumps noticed in the gravity readings of the previous cruise. The bottom gravity readings showed that corrections made in the data on the basis of discrepancies noticed at the intersecting ships tracks were justified. Additional magnetic data were collected while the ship steamed between gravity stations, allowing extended coverage over areas of interest.

Equipment

A brief description of the equipment used in collecting and processing the data is included here. A more detailed description is given in the cruise reports cited above, which are available as part of the Geological Survey of Canada Open File system. The philosophy and technique used in contouring and processing the data by computer is described in detail by Haworth (1974).

The total magnetic field was recorded directly in nanoteslas every six seconds from a proton precession magnetometer towed approximately 200 m behind the ship. The data were presented both as total magnetic field and as the magnetic anomaly, the latter calculated by comparison of the total magnetic field with a reference field obtained from the International Geomagnetic Reference Field (IAGA 1969).

The shipboard gravity data were collected using a Graf-Askania sea gravimeter mounted on gyro-stabalized base. The value was recorded as the average of the signal from the gravimeter for a period of 50 seconds. This value was then processed to produce a value in conventional gravity terms (Haworth and Loncarevic (1974)).

Bottom gravity data were collected on LaCoste-Romberg underwater gravimeters, and tied into existing onshore surveys by reference stations at BIO pier in Halifax and Shelbourne, N.S.

The potential field data were contoured using a computer based technique to produce a series of maps of the free air and Bouguer gravity anomalies and the total magnetic field and magnetic anomaly. These have been published as the Natural Resource Maps of the area (15146, 15136, 15126, 15124, 15134).

Potential Field Maps of the Study Area

In order to facilitate the interpretation of the lithology and structure of the study area of the Bay of Fundy and the Gulf of Maine, data obtained on the BIO surveys, plus the published data of other institutions from surveys in adjoining areas, were combined to produce magnetic anomaly and Bouguer anomaly maps of the region between 41°N and 46°N and from 63°W to 73°W. These maps were made to be compatible with the 1:1,000,000 scale Lambert Conformal projection maps published by the Canadian Hydrographic Service for that area in order to aid the regional compilation of potential field data underway concomitantly at BIO and to make use of data already present in this form at BIO.

Data values at the junctions of the individual surveys were compared for goodness of fit and continuity. Where necessary the base level was adjusted to bring the data from the various sources to the reference datum of the BIO data. If a conflict arose over the position of a contour at the junction of surveys, a visual best fit approximation was made, with the final position being weighted in favour of the more densely sampled position. In this case the contour was shown as a dashed line to indicate the uncertainty of its position.

3.2 Magnetic Anomaly Map

The data used in the compilation of the magnetic anomaly map for the Bay of Fundy and Gulf of Maine came from the following sources:

1) data collected in the Bay of Fundy and eastern Gulf of Maine by BIO during the cruises mentioned previously and made available to the author as the basis for an interpretation of the geology of the area.

2) data compiled by P.J. Hood from aeromagnetic data as part of his regional compilation of the Canadian Maritime Provinces and made avail-

able to the author by BIO.

3) data published in the report of Kane et al (1972) in their study of the potential field of the Gulf of Maine.

The map presents the magnetic anomaly remaining after the effect of the main component of the earth's magnetic field has been removed. In the data of the BIO and of Hood, the main component was removed by referencing to the International Geomagnetic Reference field (IAGA 1969). The data for the Gulf of Maine taken from the report of Kane et al (1972) were reduced by a method that was not well documented in the literature except that the data were referenced to an arbitrary datum.

Consequently, it was found necessary to raise the datum used for the data of Kane et al (1972) by 800 nT (thereby reducing the magnetic anomaly values by 800 nT), in order to bring the two portions of the data to a common level. The 800 nT datum difference was based mainly on the coincidence of contours in the southeast portion of the map, at the junction of the Kane data and the data obtained by the BIO. Contours were joined on the basis of the 800 nT datum difference progressing from south to north. After all the contours had been joined, the data compiled by Hood were overlain and found to coincide exactly with the Kane data on the adjusted datum.

The magnetic data for the Gulf of Maine and the surrounding land areas were obtained from an aeromagnetic survey flown by the USAF as part of project 'Magnet'. Lines were flown at a height of 200 m over the Gulf and 500 to 800 m over land at a flight line spacing of 8.0 km. Data for Canadian land areas were obtained from aeromagnetic surveys flown at an average line spacing of 0.8 km at altitudes of 150 to 300 m. Data from water covered areas were obtained from shipborne surveys using a towed magnetometer, on lines that varied in spacing from 1 km to almost 25 km. In the Bay of

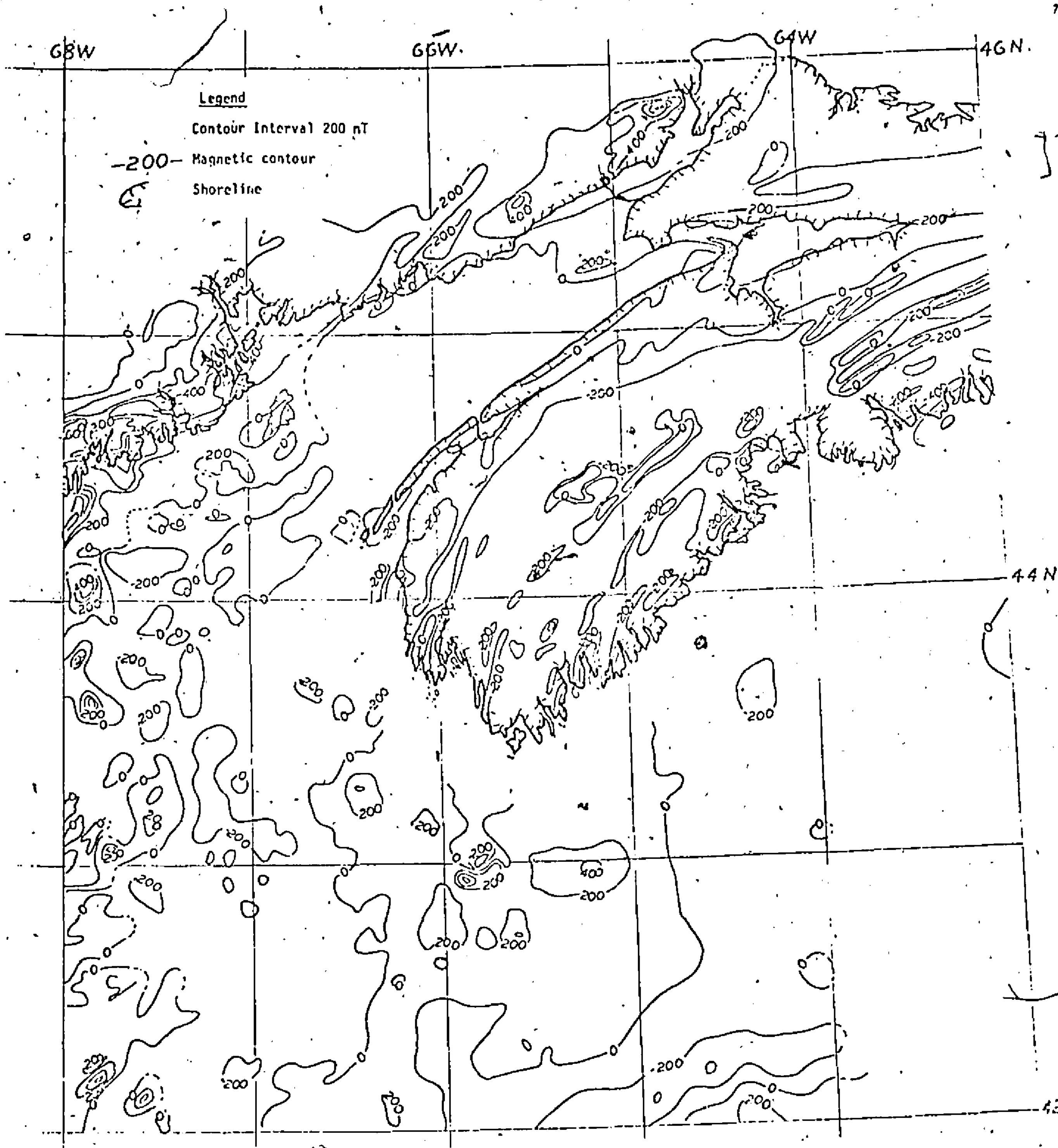

Fig.8 Magnetic Anomaly Map of western Nova Scotia and the Gulf of Maine

Fundy and approaches the shipborne survey coincides with an aeromagnetic survey. The latter has not been incorporated into the map of the magnetic field (Fig. 8) but was consulted whenever more densely sampled data than provided by the shipborne survey was needed.

The data are presented at a scale of 1:1,000,000 on a Lambert Conformal projection. The Canadian data were already available in this form; the Kane data were plotted to the same scale, but on a slightly different projection. This required some approximation in the position of the contours. An overlay was centred on each 1° square in succession and the contours in that square drawn. In this way the contours in each 1° square are in a reasonable approximation of its actual position, and the overall error in position can be considered negligible.

3.3 Bouguer Anomaly Map

The data used in the compilation of the Bouguer anomaly map (Fig. 9) for the Bay of Fundy and Gulf of Maine came from the following sources:

1) data collected concomitantly with the magnetic data by the BIO in the cruises previously mentioned.

2) data compiled by the Earth Physics Branch of the Department of Energy, Mines and Resources and published as map #149 of the Gravity Map Series.

3) data published in the report of Kane et al (1972) in their study of the potential field of the Gulf of Maine, and in map GP-839 of the Geophysical Investigations of the U.S. Geological Survey.

The map presents the Bouguer gravity field after all the necessary corrections have been made. All land surveys were corrected for elevation

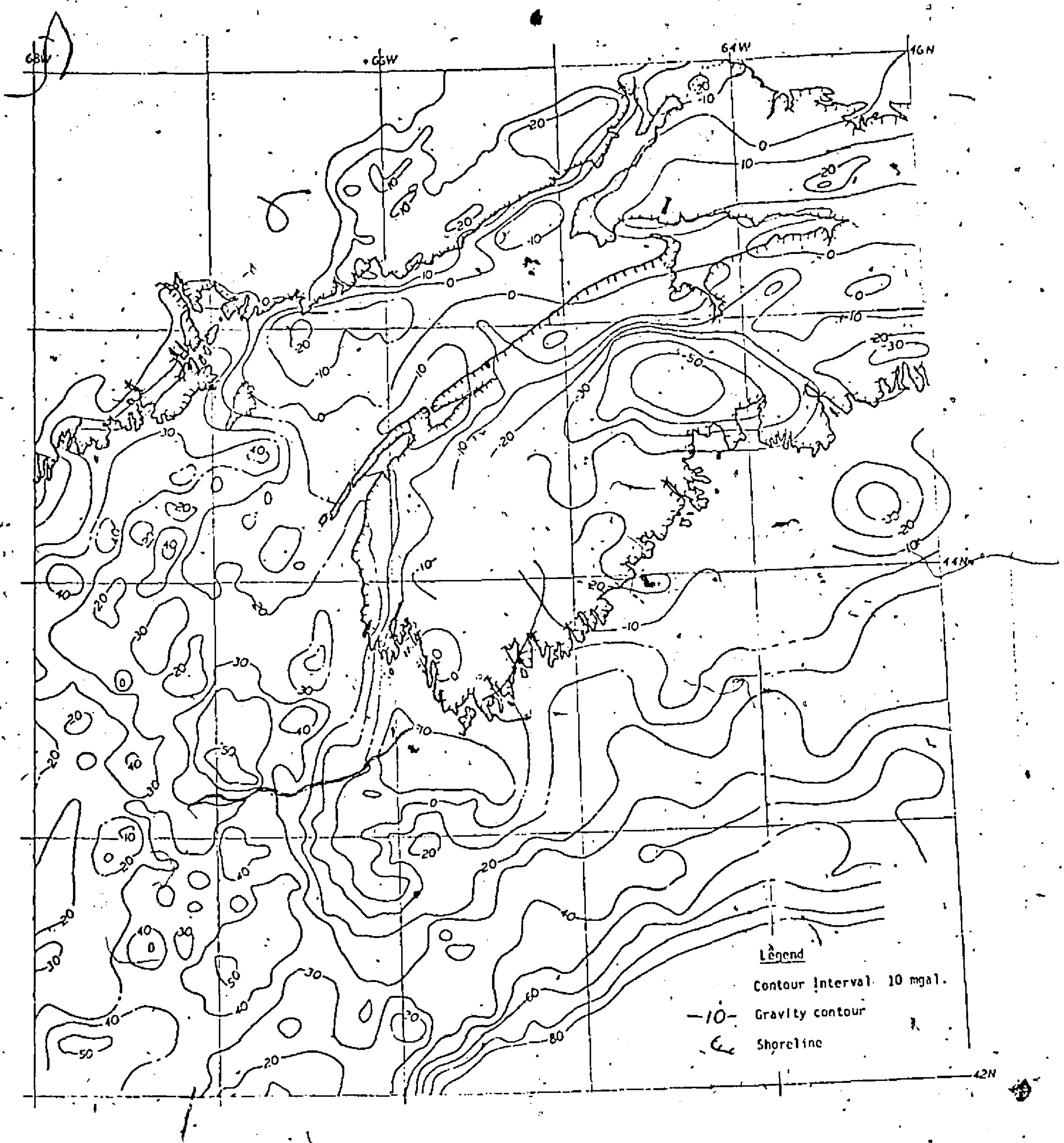

Fig.9 Bouguer Anomaly Map of western Nova Scotia and the Gulf of Maine

using a density of 2.67 gm/cm^3; the data collected in the Bay of Fundy and Gulf of Maine by BIO were corrected using an assumed density of 1.03 gm/cm^3 for sea water and 2.67 gm/cm^3 for rock; the data from Kane for the Gulf of Maine were corrected using an assumed density of 2.80 gm/cm^3 for rock, with no value given for the density of sea water used in the calculations. Since no density was given it was assumed that 1.00 gm/cm^3 was used in the calculation of the Bouguer gravity. This will lead to a difference in the density contrasts used in the correction for the Bouguer effect of 0.16 gm/cm^3 between the two marine gravity surveys, and an error of:

$$g = 0.039 \times \Delta d \text{ mgal/meter of water depth}$$
$$= 0.039 \times 0.16 = 0.0064 \text{ mgal/m}$$
$$= 0.64 \text{ mgal/100 meters}$$

The water depth in the Gulf of Maine varies from less than 100 m to over 370 m. Consequently the values presented by Kane et al (1972) for the Gulf are 0.6 to 2.5 mgal higher than the data processed by BIO for the corresponding area. This has not been adjusted but should not distort the overall interpretation of the data.

Data collected in the Bay of Fundy and Gulf of Maine by the BIO consist of surface gravity measurements taken on east-west and northwest-southeast ships tracks at a spacing of approximately 15 km. All surface measurements are tied to the Canadian gravity net by calibration readings at ports of call during the cruises. The surface gravity measurements were checked by readings taken with an underwater gravimeter on a later cruise by the BIO.

The Earth Physics Branch results were compiled from land gravity and seafloor surveys. The land based data were collected on roadside surveys, which tend to give higher concentrations of data near the coasts of the Atlantic Provinces due to the distribution of roads. The control available along the coastlines allows a good correlation of the marine data with the land based gravity data.

Gravity data for the western Gulf of Maine (Kane et al (1972)) were obtained from both bottom and surface surveys. Surface data were collected on north-south and east-west ships tracks spaced at about 16 km. Data collected from bottom stations covered 80% of the surface areas surveyed on a 16 km grid that generally coincided with the intersections of the ships track.

A 3 mgal discrepancy was noticed between the surface and bottom surveys of the western Gulf and a RMS error of 5.3 mgal was observed at 112 ships track intersections in the BIO data.

Additional Sources of Data

These magnetic anomaly and Bouguer gravity maps are the main source for the interpretation of the potential field data of the Bay of Fundy and Gulf of Maine. However, these maps were coincident with areas of aeromagnetic and shipborne magnetic surveys published by the Geological Survey of Canada (GSC maps 7032G, 7033G, 7036G, 7037G, 7291G, 7030G). Magnetic data obtained from these maps were used to supplement the magnetic anomaly map wherever the coverage was more complete, or where more detailed information about the correlation between the lithology and structure and the characteristic magnetic signal was required. Comparisons were made in areas where the coverage overlapped to check for possible errors and to allow a more complete interpretation. This overlap was particularly useful in the Bay of Fundy where the BIO survey had only collected data over widely spaced lines whereas the aeromagnetic data was available from flight lines that were approximately 1.6 km apart.

3.4 Accuracy of the Data

Most of the computer modelling developed to check the validity of the proposed geological structures is based on the gravity data collected in the area by the BIO. The ships tracks from which the potential field data were collected were rather widely spaced over most of the study area. It was felt that interpolations across such large data gaps would be more valid and meaningful for the gravity data than for the magnetic, where the values may change quite drastically over short distances.

Unfortunately the overall accuracy of the gravity data is not good. During the 1971 cruise of the BIO (cruise HUDSON 71-014) the gravimeter underwent sudden displacements (tares) that remained constant for periods ranging from 5 hours to 6 days. These tares caused 'slips' in the recorded gravity readings, producing large discrepancies in the values observed at intersecting tracks, which resulted in errors of -17 and -23 mgal in base station checks on the two phases of the cruise. A RMS error of 19.9 mgal was observed at 112 track intersections. After a system analysis of the data it was possible to reduce this to 5.3 mgal. These corrections were later checked by underwater gravimeter measurements at locations where the tares were suspected to have occurred and found to have been justified.

In interpreting these data one must bear in mind this possible error of 5.3 mgal and its effect on the final model. To emphasize this possible effect the limiting cases of maximum error were modelled. A profile coinciding with A-A' of Watts (1974) (Fig. 13) was chosen to show this effect, since a model study had already been done over the causative body and could be used as a convenient starting point (Fig. 10). If the errors are combined in such a way as to give the largest possible amplitude, an anomaly of 10.6 mgal is superimposed on the profile. As an illustration the error of 5.3 mgal is added to the largest observed value in a profile and subtracted from the smallest. This is shown as Case 1 data in Fig. 10. Case 2 occurs when the errors are combined to give the minimum possible amplitude and the profile is reduced by 10.6 mgal.

Watts had suggested an outward sloping granitic intrusion, having a density contrast of 0.15 gm/cm^3 with the host rock, as a possible cause of the negative gravity anomaly observed near Cape Sable, N.S. (Fig. 11). Models were constructed to satisfy each anomaly using a program that computes the gravity effect of 2-dimensional polygons. The models have a common upper surface for the granitic intrusion and an overall modelling accuracy of less than 1 mgal RMS error between the observed and calculated value. Figure 11 shows the results of the modelling. A marked difference in the depth extent of the granite necessary to satisfy the different profiles can readily be noticed. This same degree of error can be present in any of the models produced in this study using the contoured gravity data.

The source of the data can also have an effect on the profile produced since different methods of processing may have been used. Profile A-A' from Watts (1974) was again chosen to show this and the anomaly plotted from the following sources:

1) the map presented in Watts (1974), Fig. 1)
2) BIO contoured data used to produce the map described earlier in this chapter (Fig. 9)
3) 10 minute data from the HUDSON 71-014 cruise report (Watts and Haworth (1974))
4) 2 minute data from the listing produced when the data were pro-

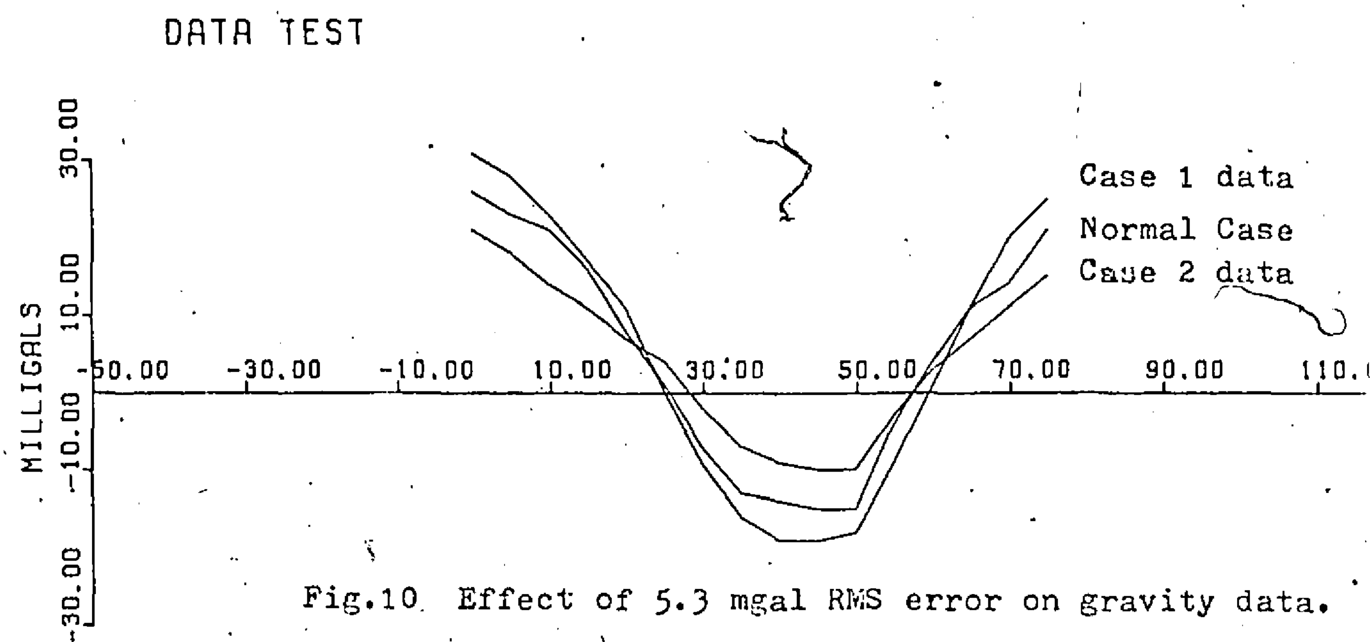

Fig.10 Effect of 5.3 mgal RMS error on gravity data.

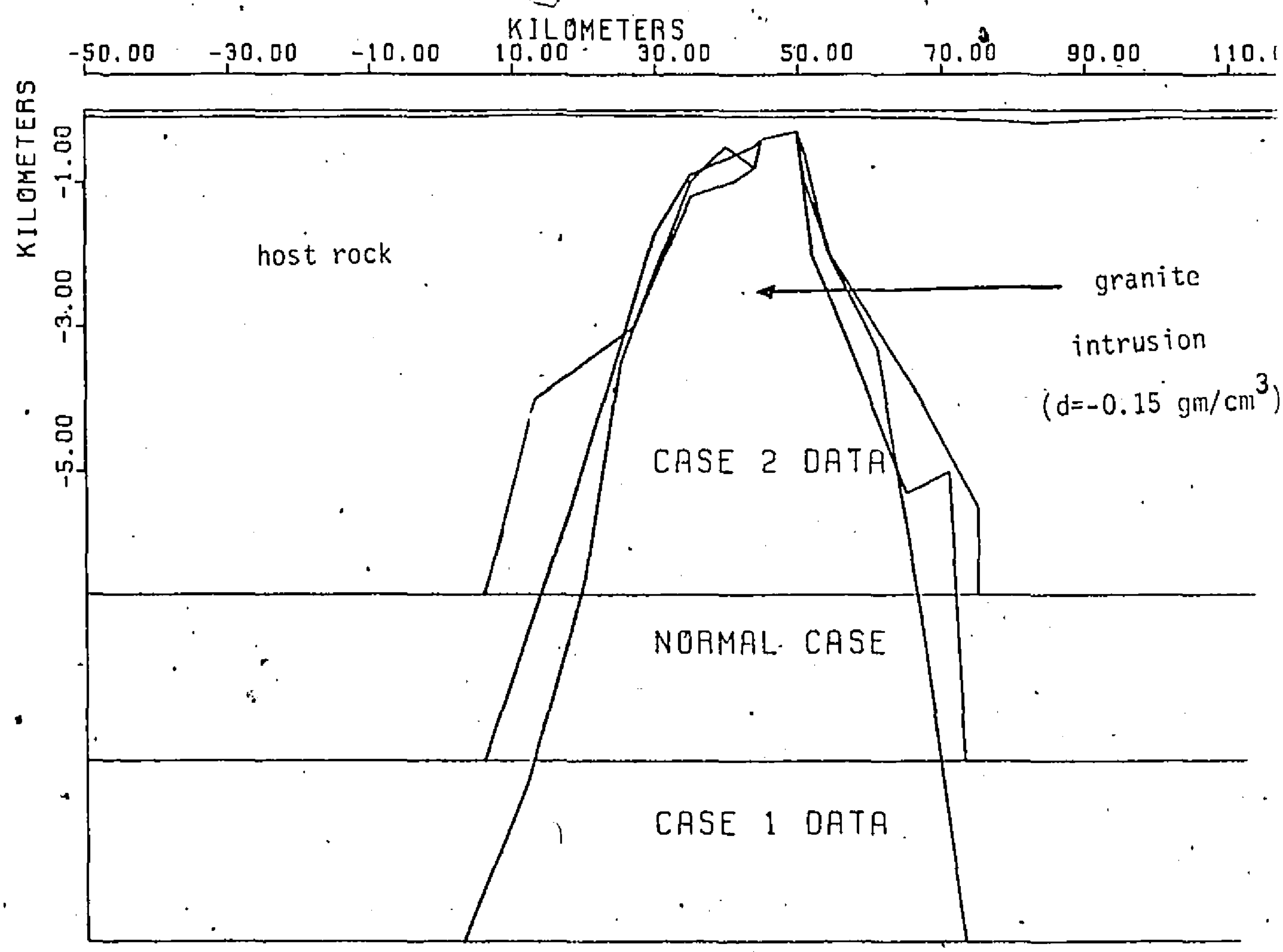

Fig. 11 Structures to satiafy gravity data shown in Fig.10.
(density contrast = 0.15 gm/cm^3)

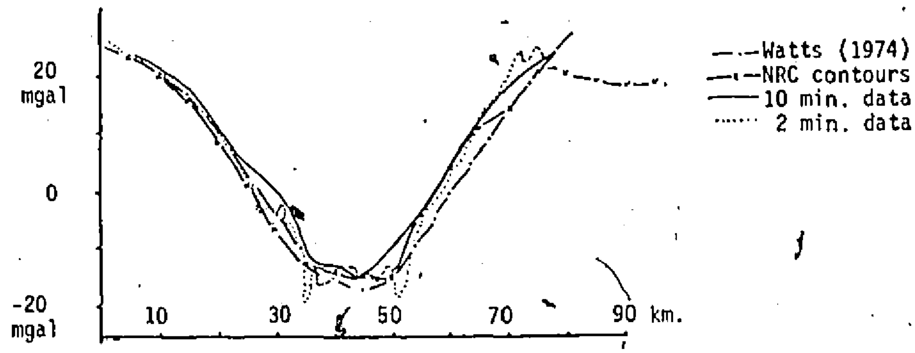

Fig. 12 Data from different sources

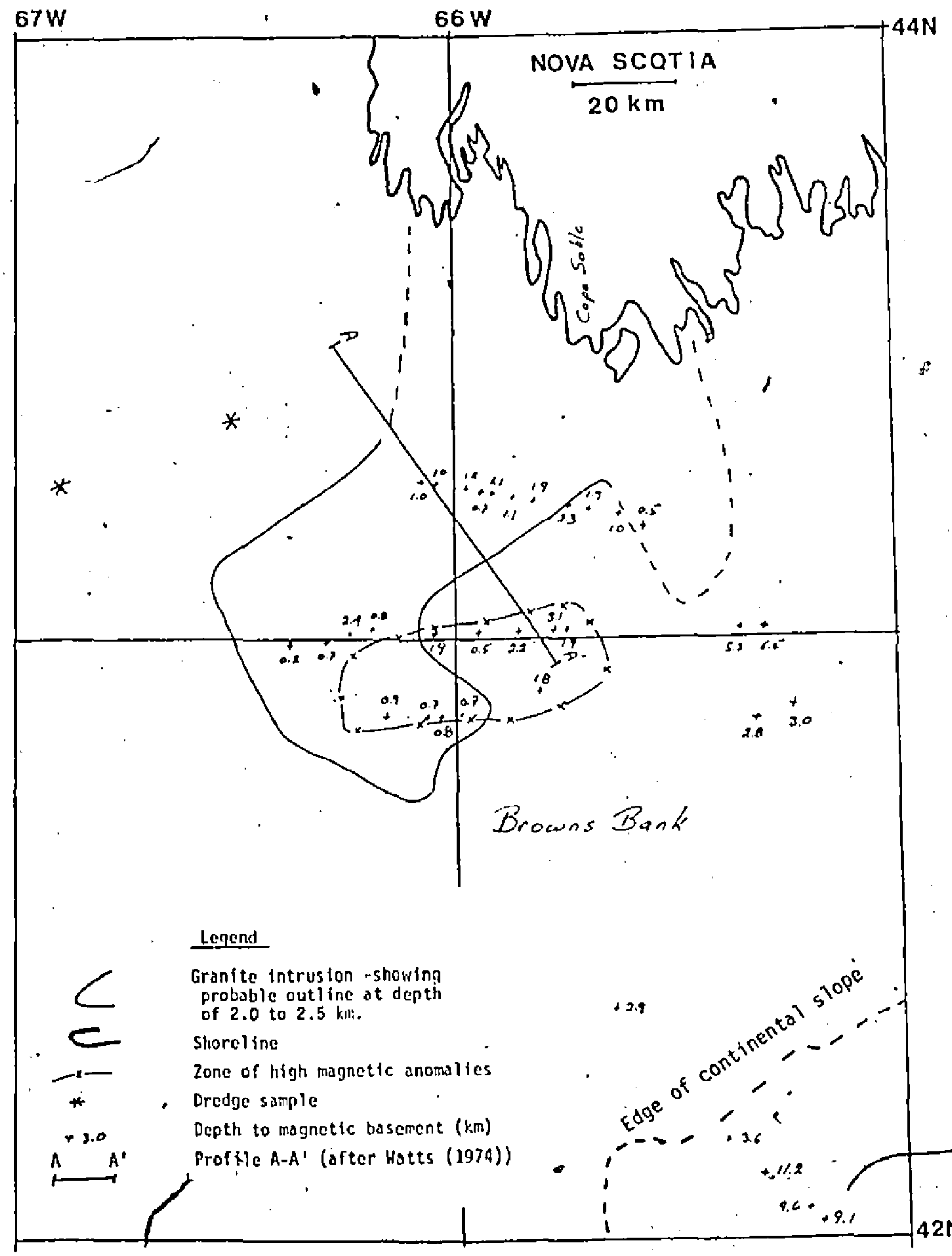

Fig. 13 Location of proposed granite intrusion causing Cape Sable gravity low, showing zone of high magnetic anomalies

cessed to obtain the Bouguer anomaly (made available by BIO).

As can be seen in Fig. 12, a variation does exist in the data from different sources, and the results of any interpretation will be dependent on the source of data used. For the purpose of this study only data digitized from the contoured Bouguer anomaly map (Fig. 9) will be used for computer modelling of the gravity data. No further attempt will be made to correct the data presented on this map. As a result, the interpretation will be subject to the same degree of error shown in Fig. 11.

The smoother profiles obtained from the contoured data supplied by the BIO will give simpler and less accurate geological models than the more precise 2 minute data, but since the quality and quantity of data available is suitable only for a regional interpretation, it is satisfactory for the present work. Modelling of the 2 minute data would be very time consuming and, considering the overall accuracy of the data and the inherent problems in interpreting potential field data, probably no more representative of the actual structure than a simplified model. Only where detailed seismic data provide additional control would use of the 2 minute data be justified.

Chapter 4. Interpretation of the Data

4.1 Introduction

Some of the characteristic geophysical anomalies observed over formations around the Bay of Fundy study area can be followed offshore for some distance and may be used to map the structure and lithology in the water covered areas. These areas, in which the geophysical trends can be related to known geology on nearby shores, will have a high confidence level associated with the interpretation and will be useful as a basis for the interpretation of the adjoining areas which have less control. Interpretation of the geology can also be used to supplement the models of the regional geology presented by previous workers in the area.

4.2 Methods used in the Interpretation

The method used for interpreting the geophysical data in the study area consisted of determining the possible cause of the anomaly and testing the interpretation by comparing it with the anomaly produced by a theoretical model. The formations causing the anomaly were identified on the basis of information derived from all the data available for the area, i.e. gravity, magnetic, limited reflection and refraction seismic data, some dredge samples and extrapolations of the onshore geology. An estimate of the size and shape of the causative body can be made from some of the characteristic features of the anomaly and used as the input parameters for a model. The method of Bott and Smithson (1967) is used for the determination of the shape characteristics of the source; it is based on the ratio of the amplitude of the anomaly and the maximum gradient observed. The maximum depth to the top of the causative body D_{max} is given by the equation:

$$D_{max} = k\left|\frac{A_{max}}{S_{max}}\right| \tag{1}$$

where A_{max} = maximum amplitude of the anomaly (mgal)

S_{max} = maximum slope of the anomaly (mgal/km)

k = shape factor
0.856 for 3-D body
0.65 for 2-D body

A depth extent was calculated using the relation of Bott and Smithson (1967) which uses the Bouguer correction to calculate the gravity anomaly caused by a horizontal sheet of infinite length, density contrast d and thickness t by the formula:

$$A_{max} = 2Gdt = 0.042\ dt \tag{2}$$

where A_{max} = amplitude of the anomaly (mgal)

d = density contrast (gm/cm^3)

t = minimum depth extent of the causative body (m)

G = gravity constant

This can be transposed to give the thickness required to produce an anomaly of known amplitude and density contrast:

$$t = \frac{A_{max}}{0.042d} \tag{3}$$

or the density contrast if the thickness and amplitude are known:

$$d = \frac{A_{max}}{0.042t} \tag{4}$$

Once the probable cause and shape of the body had been determined a model was constructed and the theoretical anomaly compared with the anomaly observed in the field. Computations of the theoretical anomaly were made using the computer program TAL15 made available to the author by Dr. R.A. Folinsbee of the BIO. This is a modification of the program described by Talwani et al. (1959), which computes the anomaly of a 2-dimensional polygon. The program then compares the theoretical and observed anomalies and performs a curve fitting based on the difference between the two anomalies. A RMS error of less than 1.0 mgal difference between the theoretical and observed anomalies was obtained. Considering the 5.3 mgal RMS error observed at intersecting tracks, this degree of accuracy in the models should be more than sufficient. See Appendix A for a listing of the computer program TAL15.

The magnetic data and depth to magnetic basement estimates were used to provide additional information for the gravity models. No model studies are presented for the magnetic data, since in most areas the track spacing was quite large and models of the regions between the tracks could be misleading, due to interpolations made in contouring the data. The magnetic data were used to define trends in the area, map the location of boundaries and to give additional control to the information obtained from the gravity data.

4.3 General Description of the Potential Fields

Gravity

A study of the gravity data of the Atlantic Provinces was made in order to define the main characteristics of the field and correlate it with the gross geology and structures of the region. It was felt that more would be learned from the gravity field about the major structural and lithological changes present than from the magnetic data. Gravity data reflect the average of all the surrounding masses and any major change in the surrounding geology will be reflected by a substantial change in the gravity field, whereas a thin cover of highly magnetic material frequently will mask the magnetic signal from a magnetic body buried under the cover.

Most of Nova Scotia and New Brunswick has an associated negative gravity anomaly, due to occurrences of Devonian granite and thick deposits of Carboniferous and Triassic sediments in the area of the Maritime Triassic Basin. Southeastern N.B., and the Northumberland Uplands of N.S. have positive anomalies caused by platforms of pre-Ordovician strata that have been uplifted and covered by thin deposits of Carboniferous strata.

The gravity field of Maine has been described by Kane and Bromery (1968), who divided the field into four zones; a region of low values in the north associated with Devonian sediments, where a minimum of -60 mgal occurs, a low of -25 mgal in the southwest caused by sedimentary rocks, a zone of steep gradients near the coast and a zone of high values found at the coast. The latter continues into the Gulf and may be associated with occurrences of mafic material. A north-south regional gradient is observed from northern Maine, where the lowest values occur, increasing to +40 mgal in the centre of the Gulf of Maine. This change in gravity level has been explained as the result of deeper basement in the interior of Maine than is found in the central portion of the Gulf.

When viewed on a large scale map the gravity field of Nova Scotia and areas to the east (Fig. 14), in the region south of 46°N, shows an over-all east-west trend. This is noticeably different than the general northeast trend of gravity in the Appalachian region along the Atlantic coast. Near Chedabucto Bay there is a gravity low (the 'Orpheus' anomaly), flanked on both sides by regions of high gravity. King and MacLean (1976) have suggested that this is a continuation to the shelf edge of the Chedabucto-Cobequid fault zone and it has been mapped by Poole (1967) as the locus of deposition during the Palisades Disturbance in the Triassic (Fig. 6). The same anomalous low, flanked on both sides by gravity highs, can be followed across Nova Scotia, where the zone coincides with the Chedabucto-Cobequid fault zone, through the Bay of Fundy to the Gulf of Maine, where the trend is lost. This trend shows a continuation of structure across the study area and may be related to the boundary of the Meguma Platform which makes up most of western Nova Scotia.

South of this anomaly trend is a large negative Bouguer anomaly on Middle Bank. McGrath et al (1971) has suggested this may be another granite intrusion, similar to that found in central Nova Scotia, which causes the large negative anomaly seen due west of Middle Bank.

In the southwest portion of Nova Scotia the gravity field is seen to change strike from the east-west trend observed further east to a northeast-southwest direction similar to that seen in the Appalachians. This may be an indication of bending of the Meguma Platform upon collision with the margin of North America, as suggested by Schenk (1971).

Unlike the land portions of the study area which often have a negative gravity anomaly, the Gulf of Maine has, for the most part, a positive anomaly. The central portion of the Gulf has a background of approximately 20 mgals, upon which is superimposed a series of positive anomalies with an overall northeast trend. The western portion of the Gulf has a higher background of 30 mgals and the trends are more north-south than northeast, indicating a change in geological structure from the central regions to the western portions of the Gulf of Maine. The only exception to the positive anomalies seen in the western Gulf is a large area of negative Bouguer anomalies seen southwest of Cape Sable, Nova Scotia.

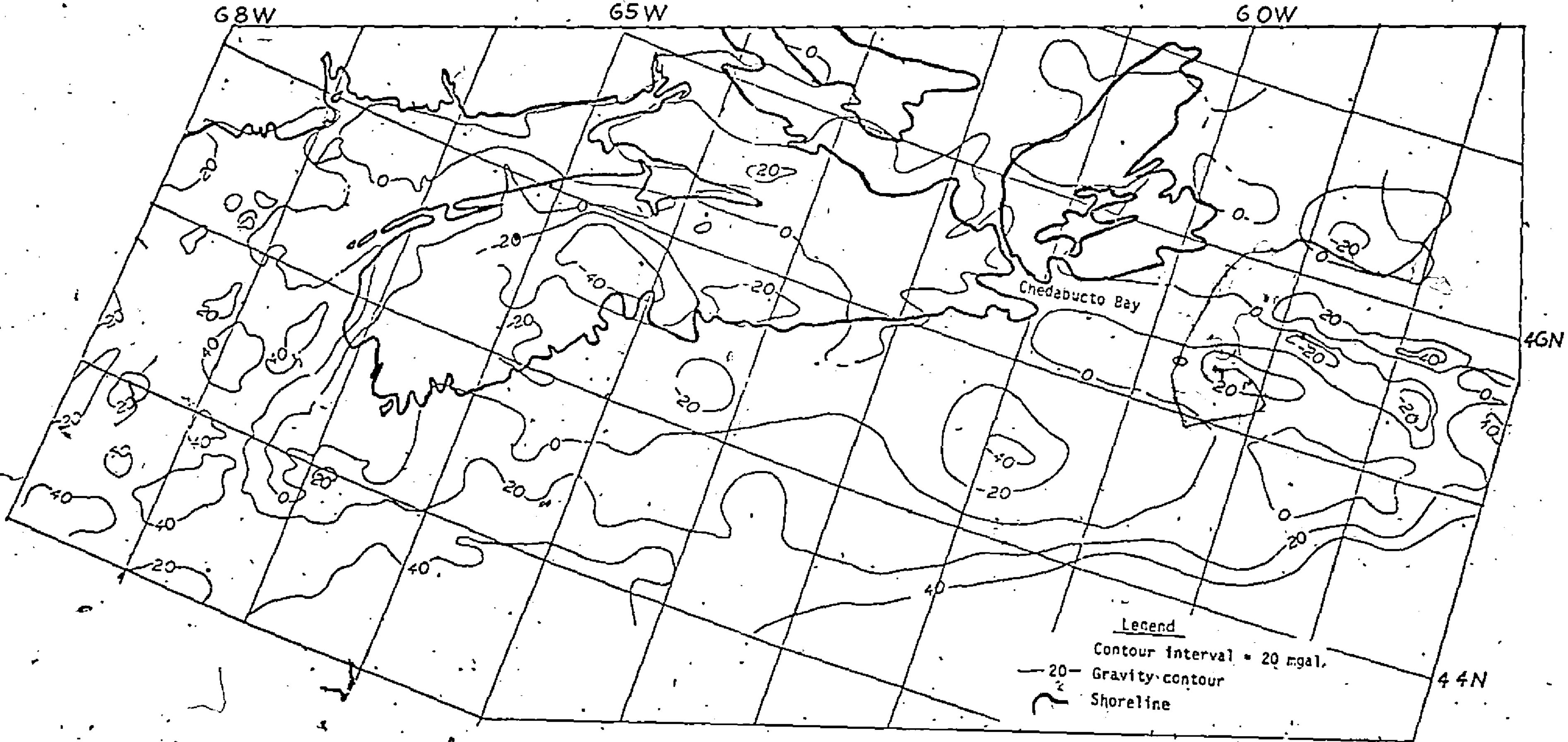

Fig.14 Regional Bouguer Gravity field of Nova Scotia and adjacent areas.

Magnetic

The magnetic field of Nova Scotia (Fig. 8) also shows a different anomaly pattern for the Meguma Platform than for the remainder of the study area. Southwestern Nova Scotia is characterized by a negative magnetic anomaly of less than -200 nT that is interrupted by positive linear anomalies produced by the Halifax and White Rock Formations. These positive anomalies are seen to change strike direction from approximately N75E in the eastern portion of the Meguma Platform, to an almost north-south direction in the area near Yarmouth. The western portion of the Gulf shows a mainly negative anomaly which is broken by a zone of positive anomalies near Cape Sable. These may be related to the extensions into the area of the Halifax and White Rock Formations from the nearby shore. The remainder of the map area shows a general northeast strike correlating with the gravity, which reflects the overall trend shown in the Appalachians.

Both the gravity and magnetic maps emphasize the difference in the potential fields of the Meguma Platform from the remainder of the study area.

4.4 Depth to Magnetic Basement Study

Studies of depth to magnetic basement were made on approximately 1300 km of magnetic data in the Gulf of Maine under a study contract of the BIO. The results of the analysis give the depth to the first magnetic interface and, with the results of other geophysical measurements from the area, may be used to determine some of the structures present in the Gulf of Maine.

In the approaches to the Bay of Fundy the depth to magnetic basement varies from 0.2 km, the water depth, to 3.0 km (Fig. 16). The shallow depths usually occur in areas of high gravity, large positive magnetic anomaly and rough surface topography, indicating the presence of a dense magne-

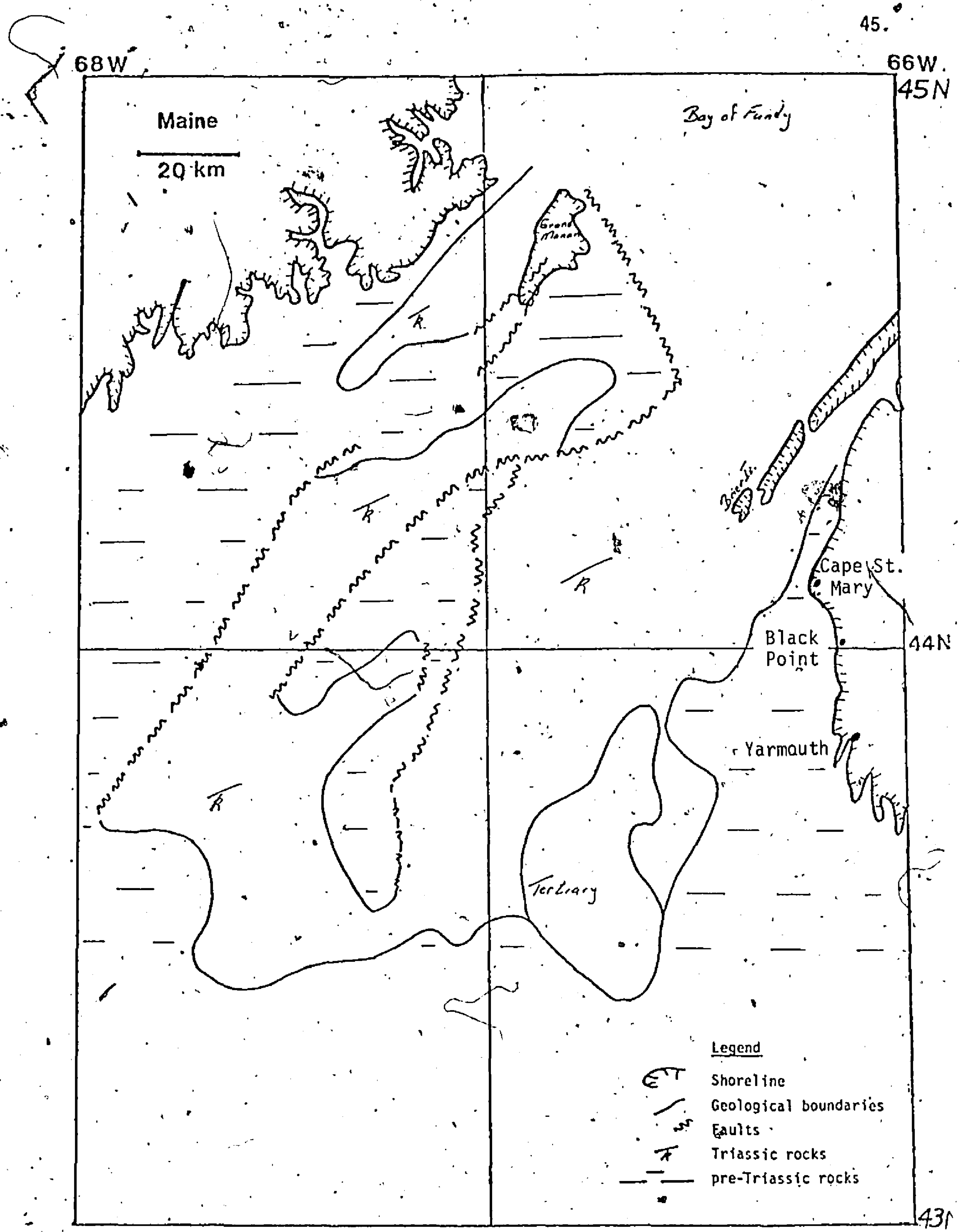

Fig.15 General Geology of the Northeastern Gulf of Maine.

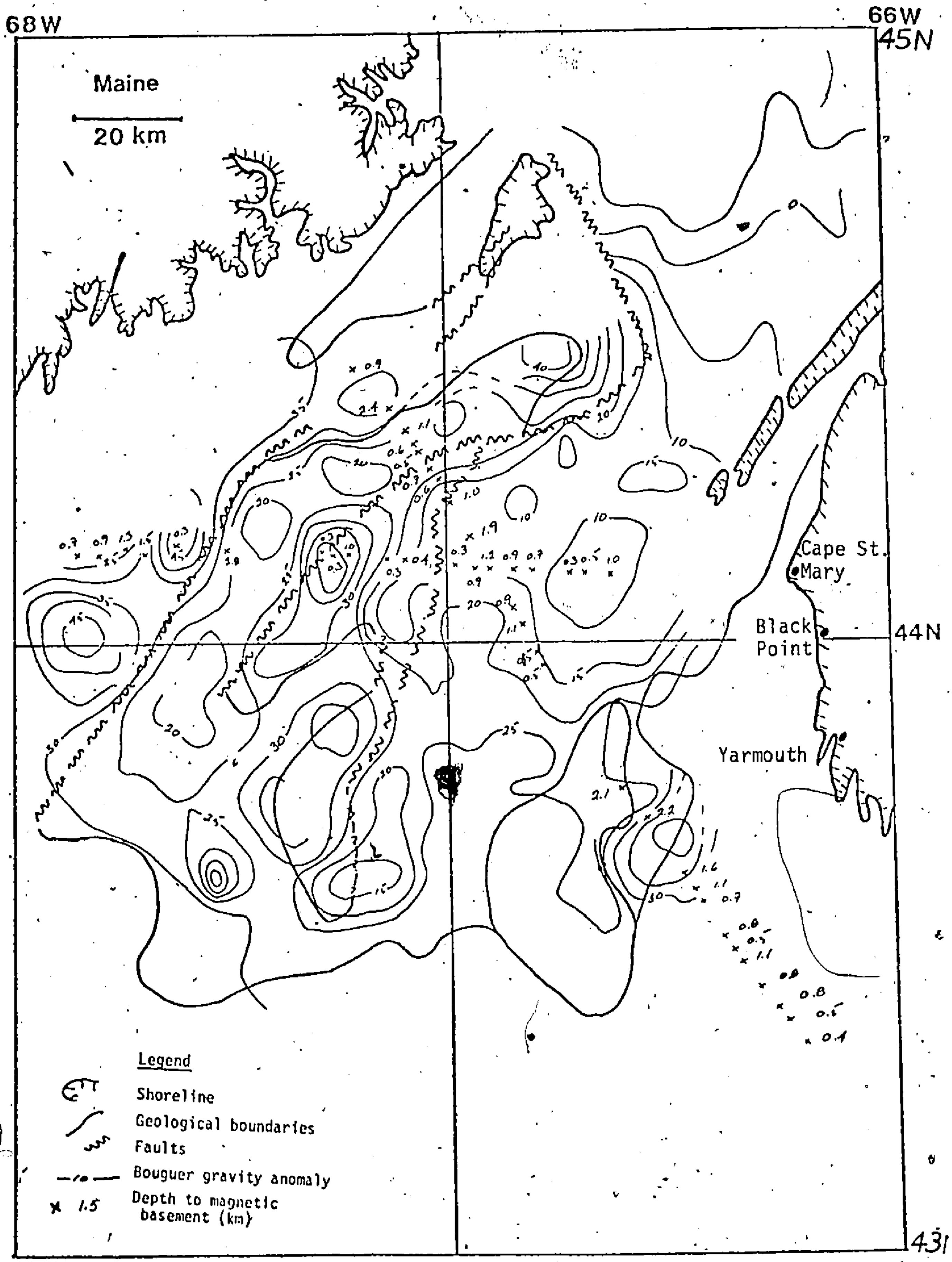

Fig. 16 Comparison of Bouguer anomaly and depth to magnetic basement.

tic rock. The areas of deep magnetic basement are usually coincident with zones mapped as Triassic sediments (King and MacLean (1976)) which show very little magnetic anomaly and a low density. At 44°10'N, 67°40'W (Fig. 16) there is a variation in the depth to magnetic basement from 0.3 or 0.4 km. to 2.8 km. The small values occur over rocks mapped as pre-Pennsylvanian basement and correlate with a gravity anomaly of 45 mgal. The depth of 2.8 km occurs over Triassic strata and has a gravity value of less than 20 mgals. Using an amplitude of 25 mgals and a thickness of 2550 m in eq. (3) we obtain a positive density contrast of 0.24 gm/cm^3 between the basement and the strata mapped as Triassic. In order to model a gravity anomaly in the range of 40 to 50 mgal it was necessary to assume a body with a density of 2.8 gm/cm^3 that extended to surface (see section 4.5.1). A density contrast of 0.24 gm/cm^3 between the material in the basin and the basement adjoining it would suggest a density of 2.56 gm/cm^3 for the Triassic sediments. This is high for sediments of Triassic age and suggests the presence of a denser, non-magnetic rock underlying the Triassic sediments in the basin.

King and MacLean (1976) have drawn a boundary based in part on a change in the character of the magnetic field immediately to the east of this basin of Triassic sediments (Fig. 15). A similar study on a basin immediately to the west of the boundary yielded quite different results. Using eq. (4) a density contrast of 0.43 gm/cm^3 was obtained for a thickness of 1600 m and an anomaly of 29 mgal. This suggests a density of 2.37 gm/cm^3 for the material in the basin which is much closer to that expected for Triassic sediments. It seems that the magnetic boundary is also the location of a major change in the geology seen in the area, since the depths to magnetic basement in the order of 3.0 km occur only to the northeast of this boundary and are associated with a formation of Triassic age that appears to be underlain by an older, denser rock. To the southwest of this boundary the gravity data are satisfied by a basin filled only with Triassic strata.

About 45 km from the coast of Nova Scotia, west of Yarmouth, another profile of interest trends northeast. A basin of depth 2.1 to 2.2 km is shown near Cape St. Mary, directly to the north of a gravity high of 40 mgals coincident with a depression in the magnetic field (Figs. 15, 16, 8). This combination of features is observed over rocks of the Goldenville formation in Nova Scotia and represents a continuation into the area of rocks of this formation. The depths of 2.1 and 2.2 km are coincident with formations mapped as Triassic sediments and correlate with a gravity of 24 mgals. Using eq. (4) again, a density contrast of 0.23 gm/cm^3 was calculated, suggesting a density of 2.8-0.23 = 2.57 gm/cm^3 for the material in the basin. This also seems high for rocks of Triassic age; there must be other rock types present in the trough. The density of 2.57 gm/cm^3 is very close to the value of 2.56 gm/cm^3 calculated for the material in the trough at $44^0$10'N $67^0$40'W in the mouth of the Bay of Fundy, and may be an indication that the same strata are present underneath the Triassic in both basins.

South of the trough observed near Cape St. Mary (Fig. 16) is a zone of irregular depth to magnetic basement that may be related to the linear magnetic trends noticed by Bower (1962), which she correlated to the exposures of volcanics in the White Rock Formation near Yarmouth. The results show that the magnetic material occurs at different depths along the profile, where the data of Bower (1962) indicate offsets that may be the result of faulting. No information can be obtained from the magnetics about the depth to the bottom of the trough, since on shore, the signal is associated with outcrops of magnetic material, rather than with material which occurs at the base of the formation. The depths shown are to the first magnetic interface and indicate nothing about the depth extent of the features.

Southwest of Cape Sable, Nova Scotia slightly off the map area of Fig. 16 (see Fig. 26) is a large zone of negative gravity. Depths to magnetic basement over this zone show a variation from 0.2 or 0.3 km to 2.3 km (Fig. 13). On one profile there is a gradual increase from 0.2 or 0.3km to 2.3km over a distance of approximately 40km that is coincident with a gravity anomaly of -15 mgals. The most obvious explanation for these anomalies is a trough of low density sediments. Dredge hauls (Fig. 13) showed few pebbles of sedimentary origin, but contained a predominance of pebbles of granitic material and meta-sediments. Watts (1974) has suggested that the gravity low may be caused by an intrusion of granitic material related to the massive granite plutons which occur in western Nova Scotia. However, the exposures of granite in Nova Scotia are basically non-magnetic and have very little magnetic signature, although it is quite common to find an aureole of magnetic material around the granite, caused by metamorphism of the country rock or by differentiation of the magma during cooling. If granite is the cause of the gravity low, the magnetic basement could be the aureole of metamorphosed rock that is commonly found around exposures of granite in Nova Scotia. Interpretation of structure based on the depth to magnetic basement would lead to false conclusions due to the uncertain cause of the magnetism found in the area.

A deep magnetic basement is found south of the Cape Sable gravity low over most of Browns Bank (Fig. 13). Values are usually greater than

1 km and reach a maximum of 6.5 km near 43°N, 65°20'W. This area of very deep basement occurs on the gravity gradient associated with the granite intrusion which is believed to cause the Cape Sable gravity low. Any difference in density between the material found in the trough and the surrounding rock is obscured by the gravity gradient.

At the limit of the survey area, at 42°N, 65°W, (Fig. 13) a trough with a depth of 11.2 km is shown on the continental margin. The deep magnetic basement occurs within a zone of negative magnetic anomalies that follow the edge of the shelf at a water depth of 1000 to 2000 m. The magnetic basement is quite shallow at the top of the continental slope where a depth of 0.2 km was calculated and falls off rapidly to a depth of 11.2 km approximately 20 km away. No gravity data are available for the area to help determine the structure.

Other lines have been interpreted for depth to magnetic basement in the Gulf of Maine, but at present the control provided by the other geophysical methods is not sufficient to allow evaluation of the results in terms of structure.

4.5 Interpretation of Structures and Lithology

4.5.1 Offshore Continuation of Meguma Series of Western N.S.

Data Available

At present there are two main sources of data that yield information about the offshore structure west of Nova Scotia. The first is a seismic refraction profile reported by Drake et al (1954), which showed the presence of a trough in the sub-basement, filled with low velocity rocks (Fig. 17). The other source of data for the area is derived from potential field measurements (Bower (1962), Watts and Haworth (1974), Parrott (1974)), and seismic reflection lines from BIO cruise HUDSON 71-014.

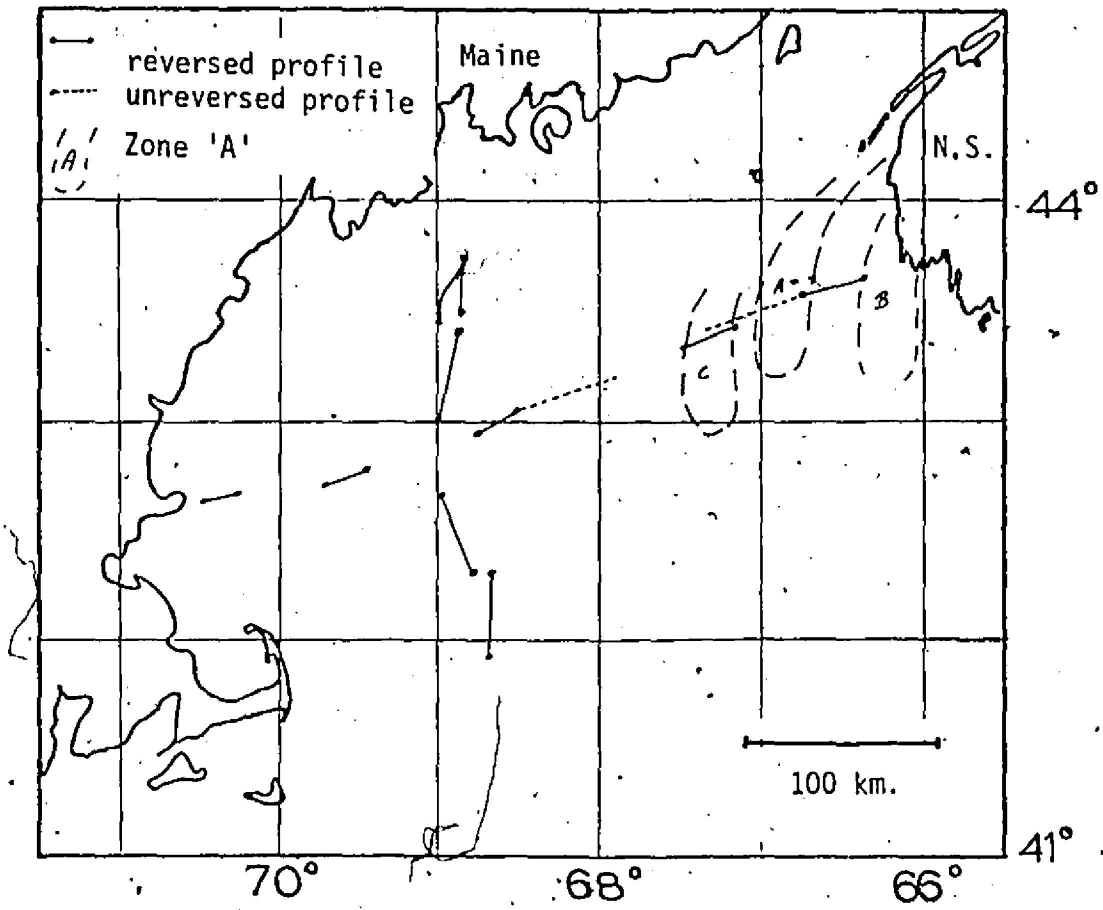

Fig. 17 Position of seismic refraction profiles in the Gulf of Maine (after Drake et al (1954)) showing the locations of Zones A,B and C referred to in the text.

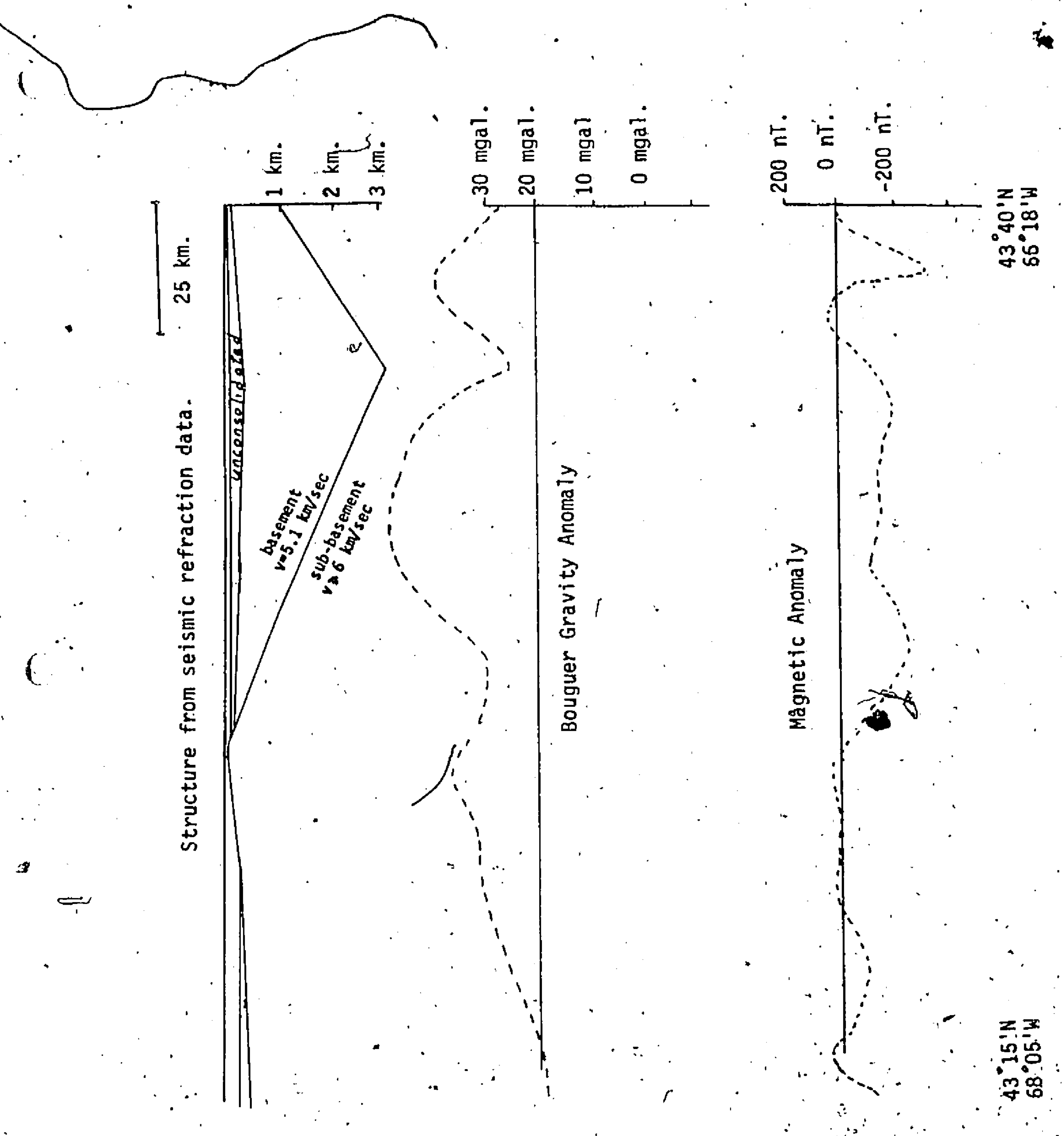

Fig.18 Comparison of structure interpreted from seismic refraction profile west of Yarmouth (Drake et al (1954)), and gravity and magnetic data made available by BIO.

The seismic refraction data and potential field data yield information that is suitable for a regional interpretation of the structural relationships, but not for a detailed interpretation of the geology of the area. Refraction data near N.S. consists of two reversed profiles (27 and 31 km long) and one unreversed profile (Fig. 17). Refraction profiles of such length will, as mentioned previously (p. 8), result in a loss of detail in the seismic velocities determined for the near surface rocks, but will give a better determination of the discontinuities and velocities at depth. Structures shown by the interpretation of the data will be the average of all structures present. The interpretation made by Drake et al (1954) (Fig. 18) on the data collected in the Gulf shows the simplest structure that can possibly be present. Models were constructed using depths calculated from the reversed profiles. These depths were assumed to occur below the receiver locations and the structure represented as a plane interface between these calculated depths.

Potential field data in the area consist of surface gravity and magnetic anomalies collected on a grid with a line spacing of 10 to 25 km. The data should allow a rough determination of the lithology and structure but will not be used to produce a detailed interpretation of the geology.

Interpretation of the Data

Both the potential field and the seismic data show a trough approximately 45 km west of Yarmouth. The seismic profile, (Fig. 18), shows a trough, approximately 3 km deep and over 100 km wide, filled with crystalline rocks having a velocity of 5.1 km/sec., contained in a host rock with a velocity greater than 6 km/sec. The gravity field, over the central portion of the trough, shows a minimum of 23 mgals such as would be caused by a trough of low density strata in a more dense host rock.

The western edge of the seismic trough is coincident with a boundary (Kane et al (1972) ; King and MacLean (1976)), drawn on the basis of a change in the magnetic characteristics of different parts of the Gulf. The magnetic profile in the area of the trough exibits low amplitude anomalies although the average value is smaller than to the west. A depth to magnetic basement interpretation (Kane et al (1972)) in the vicinity of the trough gave a depth of 3 km which is in good agreement with the value from the seismic survey. It has been suggested (Kane et al (1972)) that the trough may be related to a broad syncline that underlies the western portion of Nova Scotia.

Further information on the structure of the trough is provided by a depth to magnetic basement study using some of the magnetic data collected in the Gulf of Maine by the BIO. One profile (profile E-E' of Fig. 20) roughly parallel to the coast of Nova Scotia near Yarmouth, cuts the seismic profile at an angle of 80 degrees on the east flank of the trough. Both the seismic data and the depth to magnetic basement estimates may be used to define the boundaries of the trough since they are almost perpendicular to the trend of the trough.

Potential field data over the trough show that the interpretation of structure from the seismic data is over-simplified and the area may contain three smaller troughs rather than a single large one. The study of the structure has been done following subdivisions made on the basis of these smaller troughs (Fig. 17) and is considered in the following sections.

Zone A

The first area to be considered is a zone of depressed gravity values observed over the deepest portion of the trough which is approximately

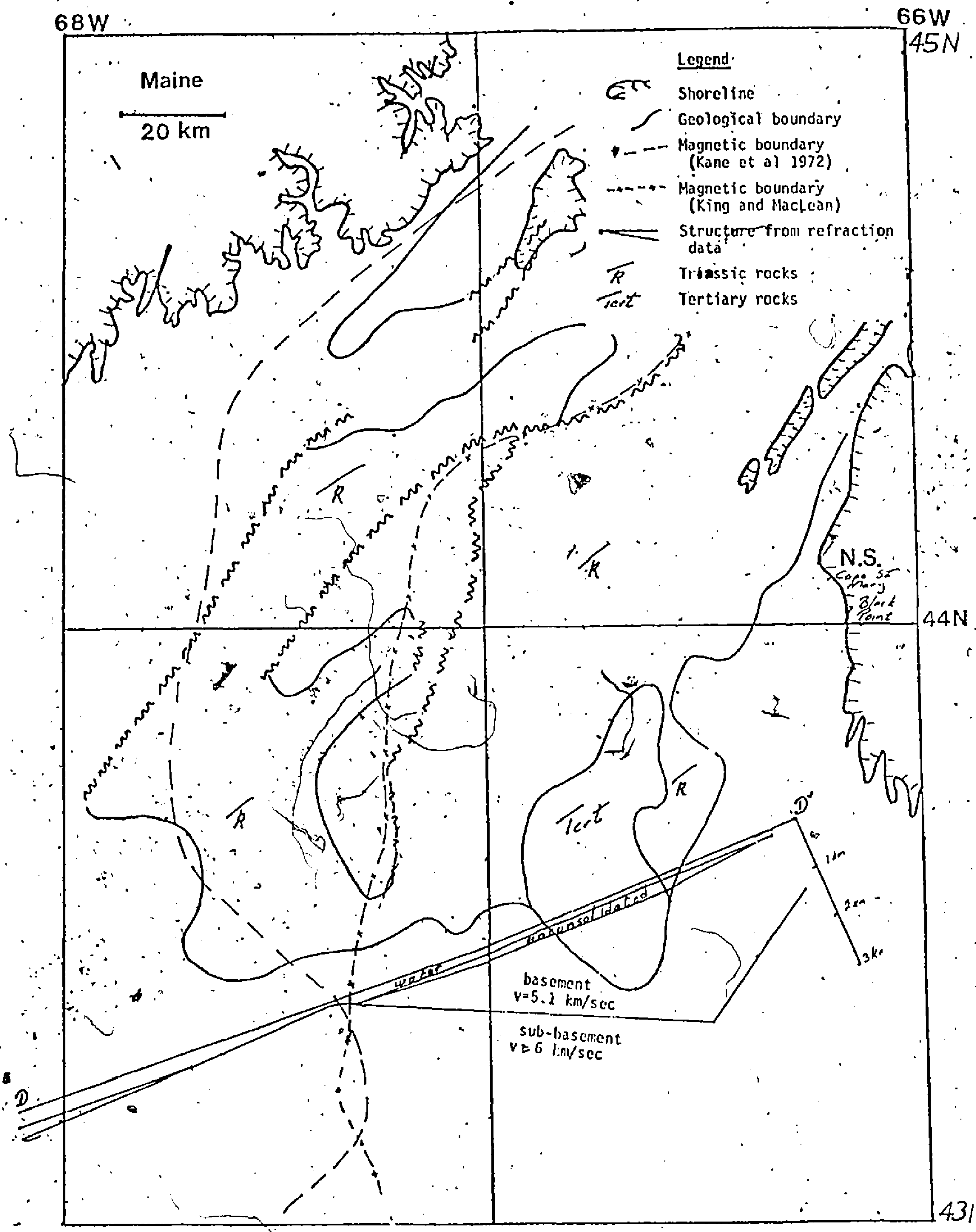

Fig. 19 Relationship between trough interpreted from seismic refraction data(Drake et al (1954)),and the general geology from Fig. 15

3 km deep at this point and overlain by 250 m of unconsolidated sediment. If the model produced from the seismic refraction data is overlain on the bedrock geology map of the area (Fig. 19) it is readily seen that the centre of the trough is coincident with a zone mapped as Tertiary and Triassic sediments, on the basis of seismic reflection data collected by BIO. However, the 5.1 km/sec velocity determined for the rocks in the trough from the refraction data is too high for rocks of Triassic age.

If it were assumed that Triassic sediments were the main component of the trough, a depth much less than 3 km would match the gravity anomaly in this area. A trough of depth 1.1 km filled with Triassic rocks with a negative density contrast of 0.5 gm/cm^3 would produce the depression of 23 mgal observed over the deepest portion of the trough.

If, on the other hand, it were assumed that the sub-basement were composed of Goldenville strata with a density of 2.80 gm/cm^3 a negative density contrast of 0.17 gm/cm^3 is required to produce the observed depression of 23 mgal (using eq. (4)). This calculated density of 2.63 gm/cm^3 for the material in the trough is higher than that suggested by the seismic data. The average velocity of 5.1 km/sec represents strata with an approximate density of 2.55 gm/cm^3, based on a relationship between seismic velocity and density (Grant and West (1965), p. 200). However, the refraction data did not indicate the presence of the Triassic sediments in the trough and the velocity appears to be an average of some other material and the overlying sediments of Triassic age.

In the vicinity of Zone A, the trough suggested by the potential field data has approximately the same depth as that determined from the refraction data, but is not nearly so wide. The gravity highs surrounding the

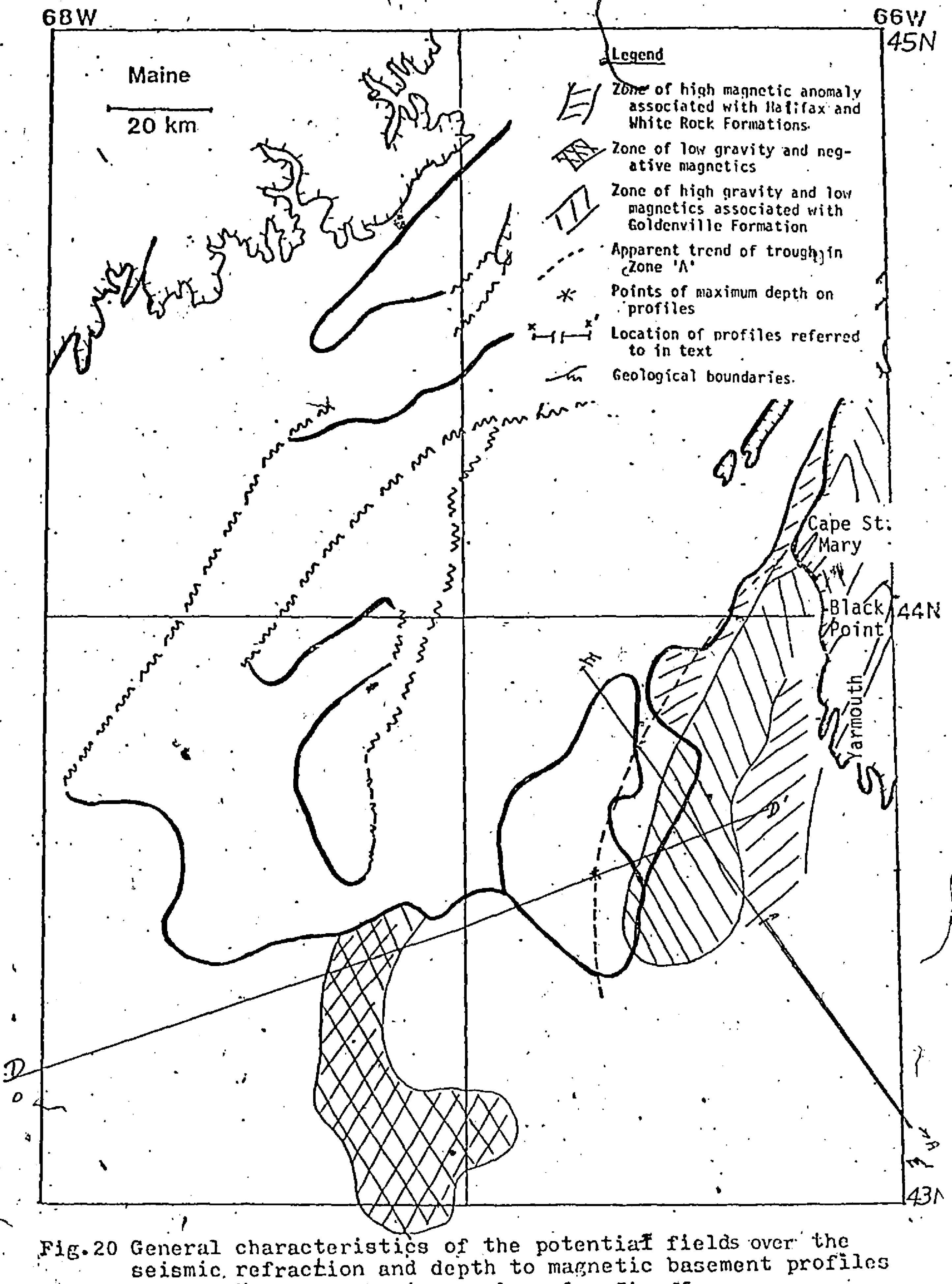

Fig. 20 General characteristics of the potential fields over the seismic refraction and depth to magnetic basement profiles west of Yarmouth, showing geology from Fig. 15

depression observed over the Triassic and Tertiary sediments, indicate the presence of dense rocks near the surface and structural relationships not observed from the seismic data. The gravity peaks correspond to areas mapped as pre-Pennsylvanian basement and to rocks of Meguma age (King and MacLean (1976)). From the potential field data it would appear that the central portion of the trough is actually a syncline in the sub-basement, the flanks of which extend to surface near exposures of Triassic strata seen in the area.

On aeromagnetic and ship/magnetic maps of the area (GSC maps 7291G and 7033G) a strong magnetic anomaly can be seen outlining the general shape and structure of the Halifax Formation, which occurs in a south-west plunging syncline in the Goldenville Formation at Cape St. Mary (Fig. 7). This magnetic anomaly may be explained by a sequence of magnetic material occurring near the base of the Halifax Formation.

The Halifax Formation is flanked to the south by an anticline in the Goldenville strata where Taylor (1969) reported 5600 m of strata near Black Point (Figs. 7 and 15). To the north the magnetic anomaly associated with the Halifax Formation is terminated upon contact with strata mapped as Triassic (King and MacLean (1976)). The anomaly can be traced seaward north-east from Cape St. Mary where it is offset by continuations of the faults that cut the Triassic North Mountain Basalt to form Brier Island and Long Island. The magnetic anomaly associated with the Halifax Formation can then be traced along a northwest strike to $43^{0}40'$N, $66^{0}35'$W, where it terminates upon contact with Triassic strata (Fig. 20).

The termination of this characteristic anomaly could be the result of masking by overlying Triassic strata. In the Bay of Fundy the same phenomena can be observed at contacts between zones of Triassic strata and the

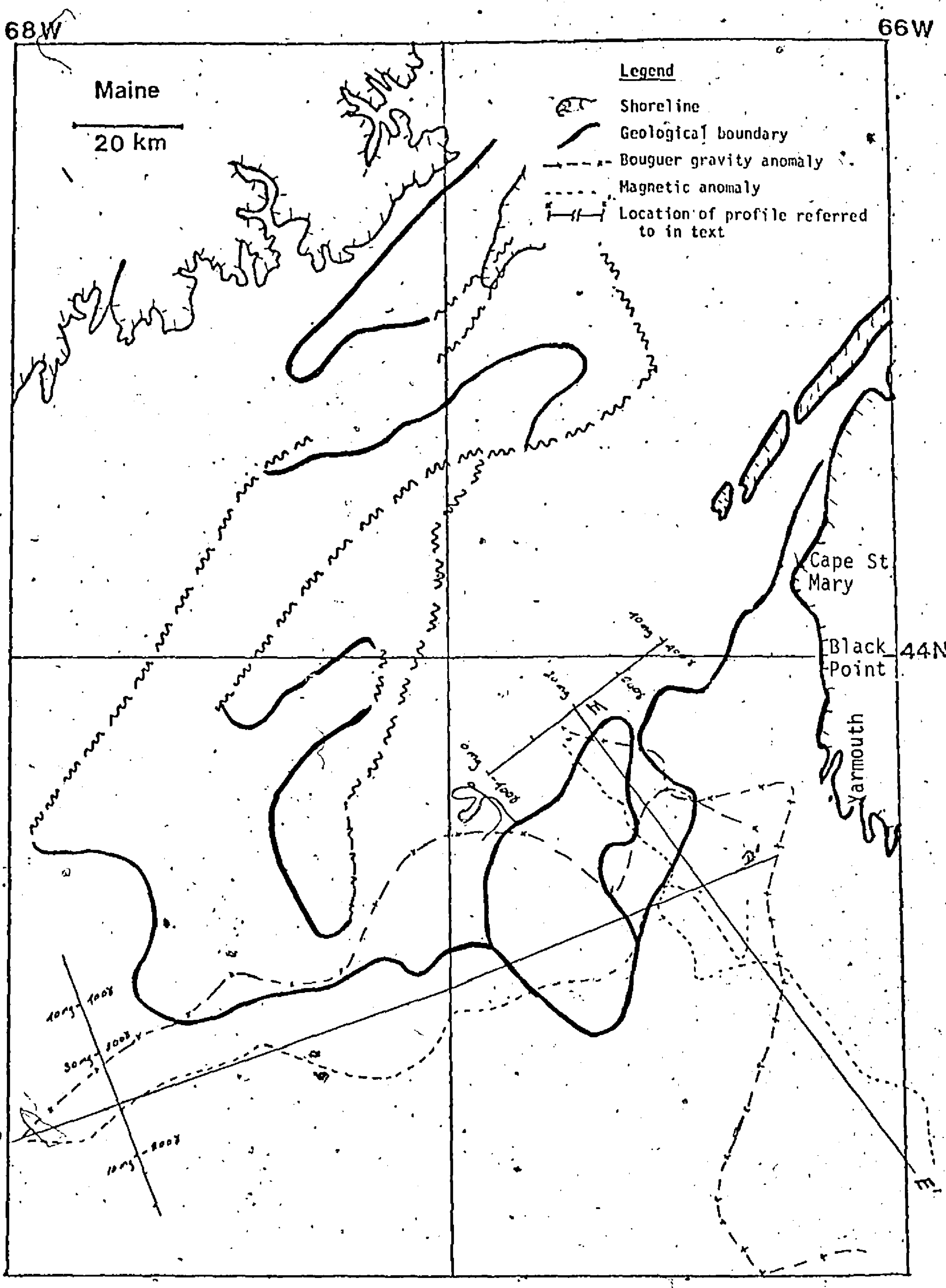

Fig.21 Gravity and magnetic profiles over location of refraction line and line interpreted for depth to magnetic basement showing general geology (Fig.15)

pre-Pennsylvanian basement. The characteristic low amplitude, low frequency magnetic anomaly of the Triassic strata effectively masks the high amplitude, high frequency anomaly associated with older strata. Also, where Triassic sediments overlie Triassic volcanics the high frequency signal associated with the latter soon disappears and is replaced by the smooth signal characteristic of the sediments.

Just east of the apparent trend of the trough are two gravity highs, coincident with magnetic lows, at 43°30'N, 66°30'W (Fig. 22). The gravity anomalies strike roughly parallel to the offshore extension of the magnetic anomaly associated with the Halifax Formation near Cape St. Mary. If extended to shore, southeast of the magnetic anomaly, the gravity feature is seen to align with the anticline in the Goldenville strata near Black Point.

Onshore gravity data does not show an anomalously high value over the anticline, but gravity readings there are widely separated and give a regional, rather than a detailed picture of the structure. Also the anticline occurs near the contact between the granite and Meguma sediments (Garland (1953)), making it impossible to separate the gravity effect of the anticline from the gravity gradient observed at the contact. A comparison of the gravity and magnetic fields along the seismic profile D-D' shows that a depression in the magnetic field is coincident with the peak of the gravity high, indicating the presence of a dense, non-magnetic rock such as the Goldenville (Fig. 18).

A comparison of the gravity and magnetic data with the depth to magnetic basement (Fig. 23) on the profile E-E' near Yarmouth (Fig. 20), lends further support to the theory of a trough in the Goldenville Formation probably filled with Halifax and White Rock strata. The trough shown on the depth to magnetic basement study occurs along the strike of the magnetic

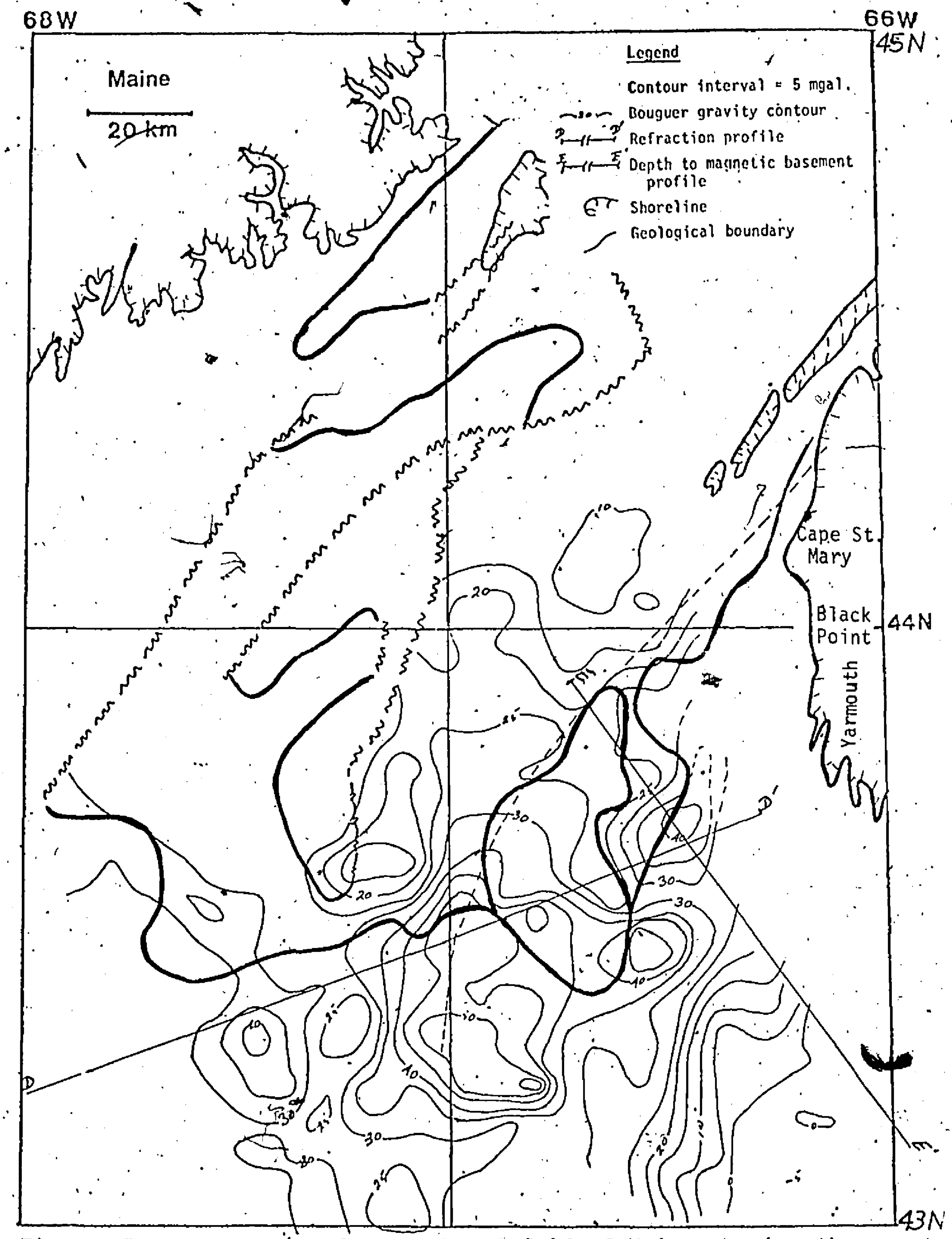

Fig.22 Bouguer gravity for northeast Gulf of Maine, showing the general geology (Fig.15)

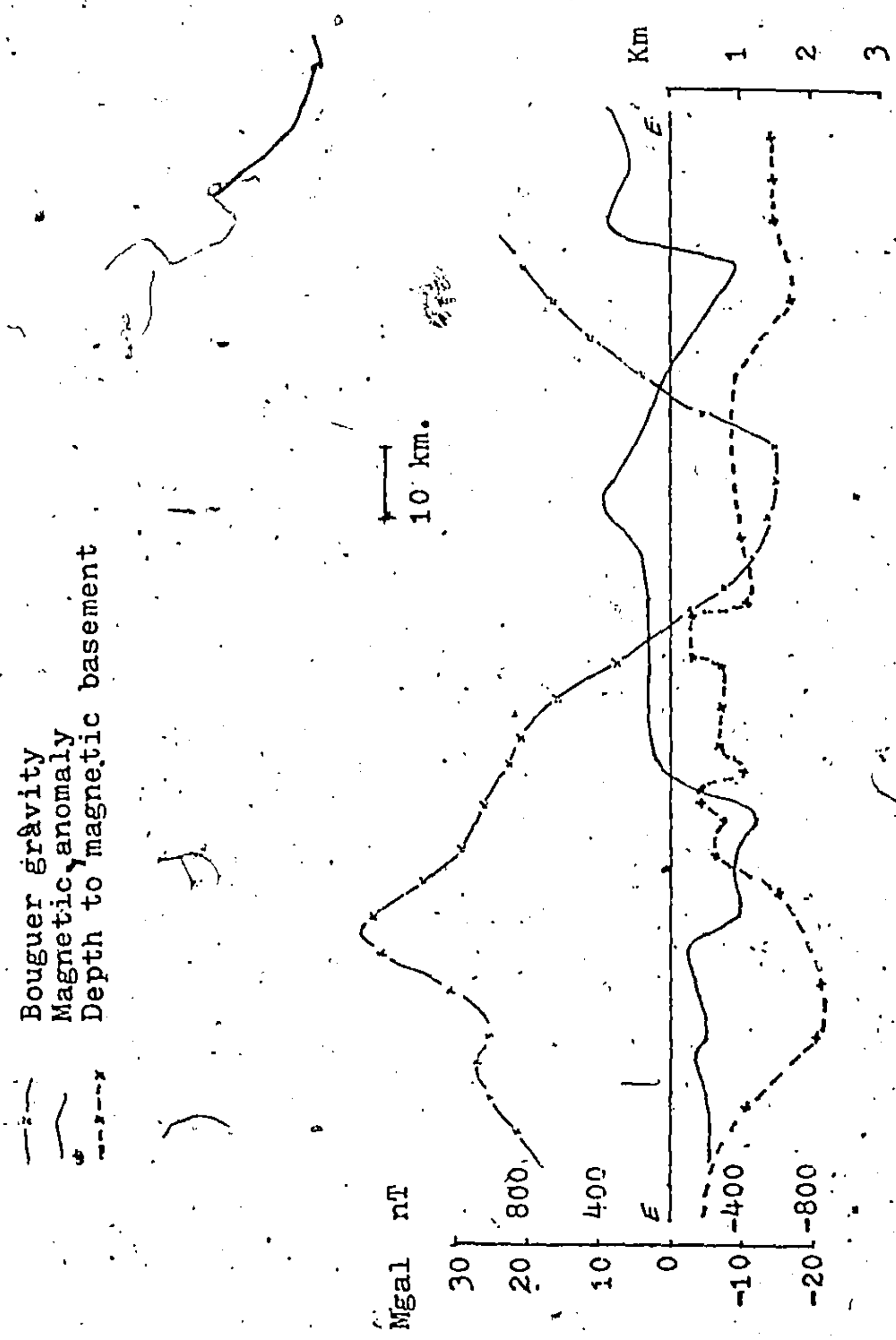

Fig.23 Bouguer gravity, magnetic anomaly and depth to magnetic basement on profile west of Yarmouth (profile E-E' Fig. 20)

anomaly associated with the Halifax Formation approximately 10 km from the termination of the anomaly on contact with the Triassic sediments (Fig. 20). It seems likely that the Halifax Formation continues under the younger Triassic sediments and forms the major constituent of the material in the trough. The magnetic basement calculation of 2.2 km would be the depth to the magnetic material observed near the base of the Halifax Formation which produces the magnetic anomaly observed on shore. The top of the Goldenville Formation, which presumably forms the trough, would be found slightly deeper than the depth shown for the magnetic basement.

The potential field data indicate a trough in the Goldenville Formation filled with rocks of the Halifax and possibly younger formations occurring in Zone A. This trough is flanked to the east by an anticline in the Goldenville Formation that is exposed at surface. It appears that the geology of the offshore area immediately adjacent to the coast of Nova Scotia is basically a continuation of the geology seen onshore.

Zone B

On the extreme east of the profile D-D', linear magnetic anomalies which seem to be continuations of those observed over the Halifax and White Rock Formations near Yarmouth suggest the presence of a depression in the Goldenville basement between the trough of Zone A and the coast of Nova Scotia. While data gaps make the interpretation of the structures and correlations of the anomalies observed in the offshore areas with the corresponding lithologic unit on shore somewhat uncertain, it is possible to extend some of the magnetic features seen over the magnetic White Rock and Halifax Formations into the Gulf. However, not all of the offshore magnetic features can be explained as continuations of those seen on shore, since they appear to be confined to the offshore area. In order fully to understand the implications of the anomalies it would be necessary to have bedrock samples of the area, to provide a firm basis for the interpretation. The present data allow an extension of the geological units that are relatively easily recognized from the geophysical data, but will not produce a complete interpretation.

There is an overall change in the strike of the magnetic anomalies, from a predominately northeast to a north-south direction (see Bower 1952). This pattern of changing strike is observed over other magnetic anomalies in western Nova Scotia and is presumably caused by the bending of the Meguma Platform during the Acadian orogeny, when the platform collided with the margin of North America (Schenk (1971)). A number of offsets may be seen in the linear magnetic anomalies that are probably caused by faulting. At 43° 33'N the offsets are particularly noticeable and Bower (1962) reported 'the anomalies seem to be offset along a line running south of west'. The offset is sinistral with a horizontal displacement of 3.5 km. Depth to magnetic basement studies over the offset show a sharp increase in depth from 0.5 to 0.8 km with the south side shallow. The fault offsets the most westerly of the linear magnetic trends but merely bends those to the east, where the strongest anomaly is located. When traced to shore this anomaly aligns with the high magnetic anomaly over the syncline in Yarmouth harbour. Outcrops of rhyolite, breccia and mafic tuff in the area may account for the high magnetic signal. This syncline seems to be one of the younger structures in the Yarmouth vicinity. The fault offsets the older trends while only bending this anomaly, suggesting that the faulting may have occurred just prior to or during the emplacement of this formation, during the Late Silurian (Taylor(1967),p. 38). Further south, near 43°15'N, the linear magnetic anomalies are again disrupted by a feature that may indicate further faulting and intrusion of magnetic material. A northeast trending zone of high magnetic values cuts the linear magnetic anomalies and appears to offset the trends, although a data gap makes the exact nature of the offset uncertain. The depth to magnetic basement study shows a steep rise in the basement from 0.8 to 0.4 km, with the south side shallow, at the site of the inferred fault at 43°15'N. South of this feature, previously continuous trends are no longer present or are offset and the magnetic characteristics are seen to change drastically from relatively non-magnetic to highly magnetic zones.

Zone C

Potential field data over the western flank of the seismic profile D-D' show that there is a change in the structure or lithology which is not evident on the seismic data. Immediately west of the trough in Zone A a Bouguer gravity anomaly of 50 mgals (in a background of approximately 25 mgal) strikes northeast, and continues north to the area overlain by Triassic sediments (Fig. 22). This feature is a portion of the zone of gravity highs that King and MacLean (1976) suggest may be an expression of the western boundary of the Meguma Platform. The location of the gravity high suggests that it may be caused by an outcrop of the northwest limb of the syncline in the Goldenville strata, which forms the trough of Zone A. The high values continue to distort the gravity contours along the projected position of the northwest limb of the syncline, even where the structure is overlain by Triassic strata to the north (Fig. 22). The magnetic anomaly on profile D-D' at this position (Fig. 18) shows a fairly uniform field of -100 nT, which drops to -200 nT over the western portion of the profile. This drop in the magnetic field is accompanied by a decrease of 25 mgal in the Bouguer anomaly to the background value of 25 mgal. These potential field characteristics are similar to those over outcrops of Triassic sediments at 43^{0} 40"N, [illegible]^{0}40'W, where a magnetic low of -200 nT to -250 nT is found (Fig. 8) in conjunction with a gravity anomaly of 25 mgal (Fig. 16). Magnetic basement studies of the area (Fig. 16) show depths of up to 3 km. The similarity of the potential field over the occurrences of known Triassic strata to that observed over the western portion of the seismic profile D-D' suggests that the anomalies may be caused by deposits of Triassic strata covering the denser basement. However, a cover of Carboniferous strata has been suggested for this area, based on a correlation of the compressive velocity observed in these strata and on Cashes Ledge with Carboniferous strata in Narragansett Bay, Rhode Island.

Sonobuoy data in the area also show a sedimentary cover over a denser bedrock. One particular measurement, at 43^{0}N, 67^{0}W (Fig. 20) gave velocities of 3.29 and 4.9 km/sec in the southern extension of the zone of relatively low gravity values seen over the western portion of the seismic profile D-D'. Using the relationship between seismic velocity and density (Grant and West (1965), p. 200)) rock formations with densities of approximately 2.25 and 2.55 gm/cm^3 are indicated. The density indicated for the second layer is much too low for Goldenville sediments. However, it is similar to average densities, calculated from the depth to magnetic basement and the gravity data, over troughs observed near Cape St. Mary and west of Grand Manan, as well as to the density calculated from the seismic refraction data over Zone A. The trough near Cape St. Mary appears to be filled mainly with non-magnetic rock of the Halifax and White Rock Formations. This trough in Zone C could be underlain by similar rock.

All data indicate a cover of sedimentary rocks, which may be of

Carboniferous or Triassic age, over the most westerly of the three troughs. The geological sequence is similar to that observed near Cape St. Mary where the Triassic strata overlie the Goldenville formation. If the structure is correctly interpreted (a cover of sedimentary rocks overlying the Goldenville strata) the outcrop of sub-basement defined by Drake et al (1954) may indicate the western boundary of the Meguma Group at this latitude.

Computer Models

Postulated structures over the locations of the seismic refraction D-D' and depth to magnetic basement profile E-E' were modelled, using the computer program described in Section 3.4, and Appendix A, to produce structures based on the gravity data. Surface boundaries were estimated from potential data over the profiles, and depths and densities adjusted to produce a difference in observed and theoretical anomalies of less than 1 mgal RMS.

Fig. 24 shows the model developed to fit the gravity data over the seismic profile D-D'. Three distinct depressions are present rather than the single trough interpreted from the seismic data. The boundary west of Zone C shows a change in the density of the rock, corresponding to a major change in the level of the gravity field and may indicate the western boundary of the Meguma Platform in the Gulf of Maine. The granite intrusion west of Zone B causes the gravity low located near Cape Sable and is dealt with in detail in section 4.5.2.

The extension of the synclinal structure in the Halifax and White Rock formations at Cape St. Mary under the Triassic strata is shown in Fig. 25. South of the syncline is a depression filled with undifferentiated magnetic formations that can be traced back to shore, where they coincide with rocks of the Goldenville and White Rock. The granite intrusion is the

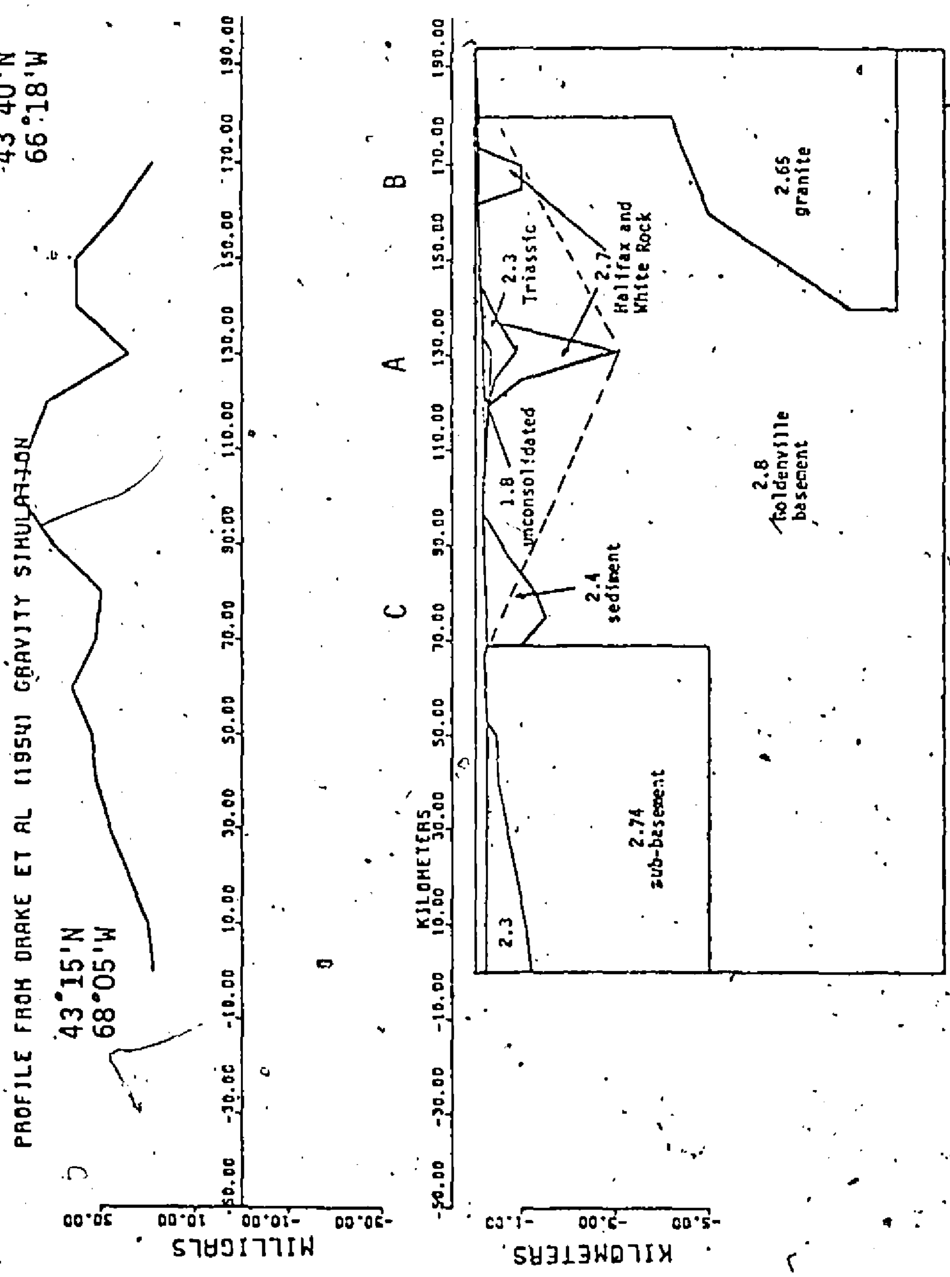

Fig. 24 Gravity model over location of refraction profile.
Dashed line shows interpretation made from refraction data (Drake et al (1954)). Densities shown in gm/cm^3. Letters show locations of zones referred to in text.

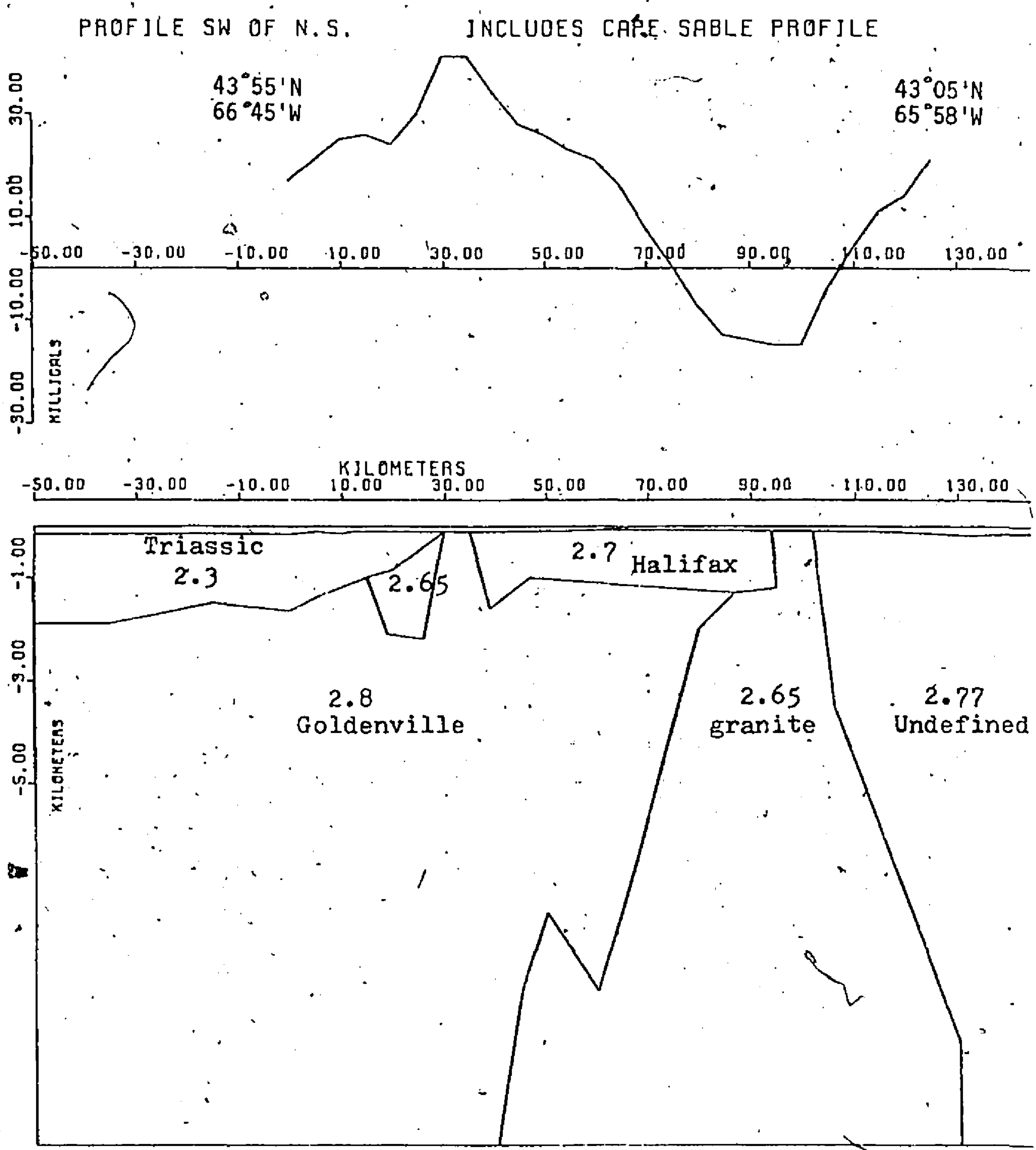

Fig.25 Gravity model over profile E-E' of Fig.20, showing densities in gm/cm^3

same body shown in Fig. 24 and is related to the gravity low at Cape Sable.

4.5.2 Cape Sable Gravity Low and Browns Bank

Cape Sable Gravity Low

During the 1971 BIO cruise to the Gulf of Maine (cruise HUDSON 71-014) a large region of negative gravity was observed southwest of Cape Sable, N.S. (Fig. 26). The gravity values attain a minimum approximately 20 km from Cape Sable. A claw-shaped area, enclosed by the zero mgal contour, extends approximately 80 km southwest of Cape Sable and reaches a maximum width of 70 km. The low extends from shore across the inner shelf bordering N.S. across the central shelf and to Browns Bank on the outer shelf. Outside the zero contour a positive gravity gradient of 1 to 2 mgal/km eventually restores the background value of 30 mgal found in the western portion of the Gulf. This gradient resembles that observed on shore between contacts of Devonian granite and the metamorphosed sediments of the Meguma Group. The area north of the gravity low is characterized by a gravity high interpreted as exposures of the Meguma rocks (section 4.5.1, p. 50). To the south the low extends to the northwest portion of Browns Bank, where its boundary marks the limit of the gravity low that dominates the gravity field of Nova Scotia. In the centre of the claw, an area characterized by a high Bouguer anomaly (20 mgal) located approximately at 43°N 66°W and a strong magnetic signal terminates the magnetic and gravity signals characteristic of the area of the gravity low.

In Nova Scotia it has been shown that negative gravity values can be caused by two sources, the Devonian granite observed over most of the western portion of the province and deposits of Carboniferous and Triassic sediments around the Bay of Fundy (Garland (1953)). In each case the magnetic field observed over these formations is relatively uniform, with long wave-

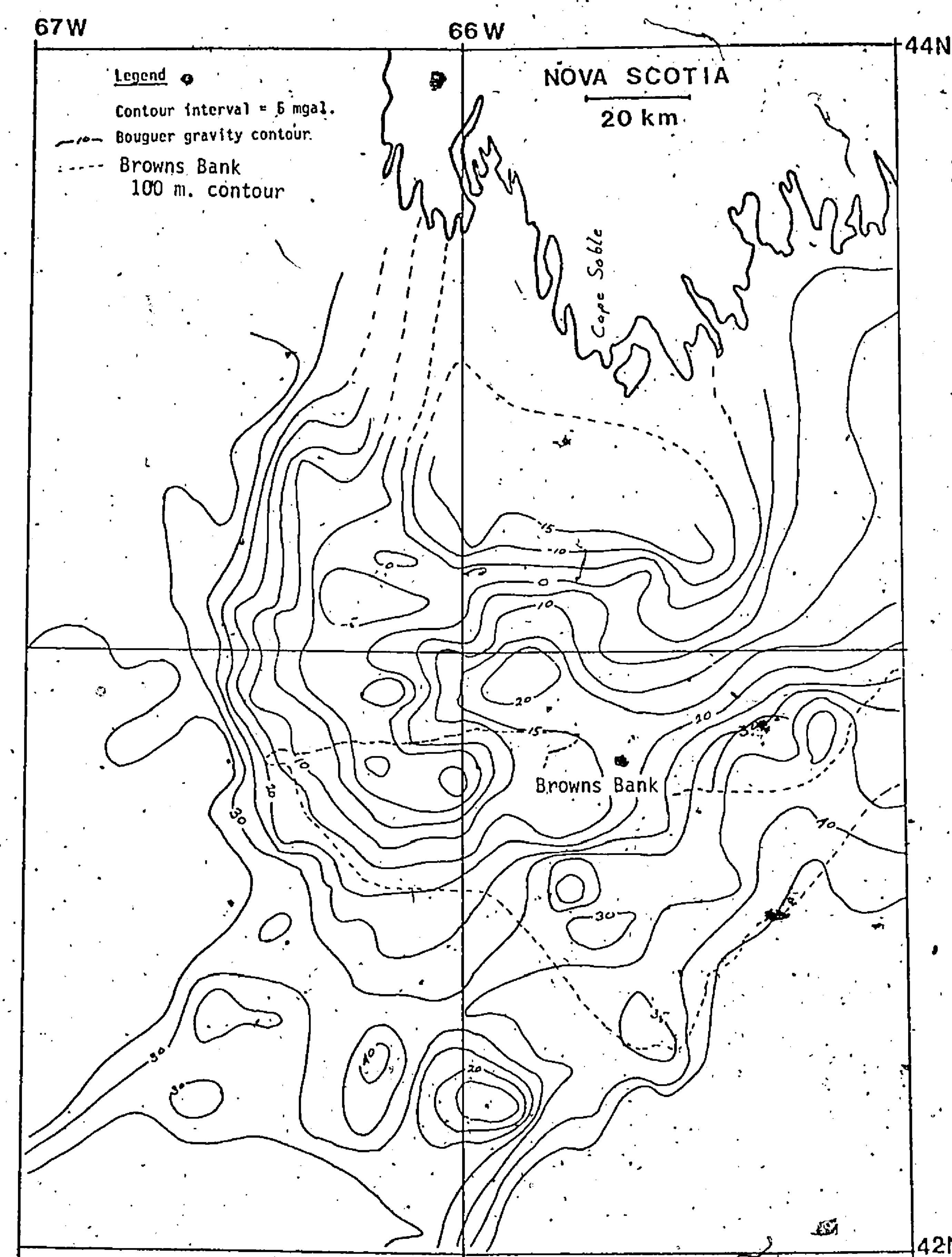

Fig.26 Bouguer gravity near Cape Sable N.S.

length anomalies. Outcrops of granite and Triassic sediments produce negative magnetic fields, while positive anomalies are associated with Carboniferous strata.

The magnetic field over the Cape Sable gravity low is rather irregular and does not correlate with the thickness of sedimentary strata necessary to produce such a large gravity anomaly. Assuming a density contrast of 0.4 gm/cm^3 between the Carboniferous sediment and the underlying host rock a thickness of 2975 m of sediment would be required to produce the observed anomaly of 50 mgal between the background of 30 mgal and the minimum of -20 mgal (seen by the original processed data) for the area southwest of Cape Sable. This amount of Carboniferous sediment would produce a comparatively uniform magnetic field, rather than the irregular field that is observed before (Bower (1962)) indicating that another formation is present and causes the gravity low.

From dredge hauls made near this gravity low (King and MacLean (1976) and see Fig. 13) predominantly of granite and diorite, acid volcanic and metamorphosed sediments were obtained. However, no occurrences of Carboniferous sediment were mentioned. The granitic pebbles could be from two sources, either the outcrops of granite noted on the southwest shore of Nova Scotia near Cape Sable and on the islands of granitic material in the area of the gravity low, or from outcrops of granite on the seafloor. These dredge samples were taken approximately 45 and 75 km from the nearest known exposures of granite in the area (Fig. 13). Granite pebbles made up 38 and 26% respectively, of the total pebble count. It is unlikely that such a high content of granitic pebbles would be present so far from the only source of granite, suggesting that there are outcrops of granite nearer the sampled sites than those exposed on land.

Watts (1974) suggested an outward sloping granite intrusion with a depth extent of 8 to 9 km as the source of the gravity low. He tested his hypothesis with computer studies to simulate the gravity field by a model with a density contrast of 0.15 gm/cm^3, which showed the interpretation was compatible with the observed data. His model showed the granite exposed at surface, although he acknowledged the fact that the granite could be buried at a depth as large as 1.5 km.

Bower (1962) noticed linear magnetic anomalies trending north-south, extending from near Yarmouth to approximately 43°15'N where the trends are distorted to an east-west direction for 5 km. These trends are replaced by a series of short wavelength anomalies with amplitudes of 200 nT that have no apparent trend. The transition from linear trends to almost random anomalies occurs at the gravity gradient of the Cape Sable low, suggesting that changes in the gravity field and the magnetic signature may be caused either directly or indirectly by the intrusion of granite.

The magnetic basement occurs at depths that vary from 0.2 to 2.4 km, suggesting that if the low gravity is caused by a granite intrusion, it is overlain in places by a more magnetic rock to provide the magnetic anomalies seen over the area. Around the granite intrusions of Nova Scotia (McGrath (1971)) and other regions around the Gulf of Maine (Kane et al (1972)) an aureole of magnetic anomalies is commonly observed caused either by metamorphism of the host rock at the contact with the granite or by differentiation of the magma. A magnetic aureole may be present over parts of the granite intrusion, and produce the magnetic field seen over the gravity low.

A model has been constructed for the gravity low, consisting of a granitic intrusion bounded on the north by a block of Meguma material and on the south by a block of undifferentiated material (Fig. 25). The strata covering the intrusion cannot be identified with the present data.

Browns Bank

Browns Bank forms the southern limit of the survey area. It is a portion of the outer region of the Scotian Shelf that parallels the shelf edge, bounded by the continental slope on the south and Northeast Channel on the west.

The gravity field of the northern portion of Browns Bank (Fig. 26) is dominated by the gravity gradient associated with the Cape Sable gravity low, which extends to the northwest portion of the Bank, suggesting the extension into this area of the granite described in the previous section. The gradient observed in the area of Browns Bank is 1.7 mgal/km which is similar to the gradients at contacts of the granite and rocks of the Meguma series observed in Nova Scotia. This gradient makes it difficult to separate the gravity signal associated with the rocks that form the Bank. Interpretation of the structures present on the Bank would be highly speculative.

At $42^{o}50'$N, 65^{o}W the Bank is terminated by a steep east-west trending scarp that can be followed for 70 km. The linearity of this scarp suggests that there may be structural control of the bedrock topography. The Bank to the south of the scarp is flat-topped while the basin to the north has very irregular bathymetry, composed mainly of a series of east-west trending sub-basins.

This area of irregular bathymetry may mark the location of a different rock type than that found on the Bank. A series of high amplitude, short wavelength magnetic anomalies is found within the boundaries of this basin. These anomalies with amplitudes of almost 2000 nT, are found on all the profiles over the basin, but coverage is not sufficient to allow determination of their strike (Fig. 13). One of these is triple-peaked and rises from -200 to 1700 nT in less than 5 km, suggesting the occurrence of dyke-like bodies of highly magnetic material quite near the surface. High magnetic anomalies occur over the entire trough and indicate that the basin may have been eroded out of this formation.

A gravity anomaly of 20 mgal over the eastern portion of the basin appears to have been produced by the same formation as the basin magnetic anomalies. However, it does not help in defining the limits of the formation, due to the gradients associated with the gravity low coincident with the western portion of the basin. The latter masks any positive gravity anomaly associated with the magnetic material that occurs there. The geophysical data indicate that the basin is formed in a dense, highly magnetic material. Similar anomalies are found over the White Rock Formation near Yarmouth (section 2.3, p. 20) where high magnetic anomalies occur over linear outcrops of volcanic material. The anomalies seen in the basin may represent an extension of this formation into the area.

The Bank itself appears to be formed from a less magnetic, but dense strata. A positive Bouguer anomaly increases in amplitude from the north to the south of the Bank. However, gradients associated with the Cape Sable gravity low and the continental margin dominate the field and obscure most of the anomaly produced by changes in the structure and lithology of the Bank.

4.5.3 Bay of Fundy and Approaches

Bay of Fundy-Data and Structures Present

Geophysical data available for the Bay of Fundy consist of gravity, magnetic and reflection seismic profiles which were collected by the BIO, a closely spaced aeromagnetic survey (GSC Map # 7036G and # 7032G) and seismic reflection data collected in the approaches and in the Bay (Swift and Lyall (1968 a and b), Tagg and Uchupi (1966)). Previous investigations of the lithology and structure of the Bay of Fundy have been summarized by King and MacLean (1976), who used seismic reflection and other data to produce an interpretation of the lithology and structure of the rock types found in the top kilometre of the floor of the Bay. This interpretation was quite complete and cannot be enlarged upon with the present data. Studies of the gravity field have been made in order to determine some of the structures at depth in the Bay and to see if the data would allow the detection of any difference in the structures on opposite sides of a ridge found near the centre of the Bay (Fig. 1). The ridge is the continuation of the Cobequid-Chedabucto fault through the Bay of Fundy and appears to represent a break in structure.

A brief description of the conclusions of King and MacLean (1976) are presented to familiarize the reader with some of the geological relationships of the area.

The Acadian Triassic Basin of the Bay of Fundy is the location of most of the occurrences of Triassic strata that occur in Nova Scotia. The locus of the Triassic sediments coincides roughly with a zone of low grade metamorphic Carboniferous strata and post-Carboniferous faults. The southern extent of Triassic rocks on land is a 15 to 20 km wide strip that forms North Mountain and underlies the Annapolis Valley, resting unconformably on rocks of Paleozoic age. To the north the contact of the Triassic with the Paleozoic rocks is mainly offshore from the coast of New Brunswick, with local exposures of fault bounded Triassic strata seen in N.B. at Point Lepreau, St. Martins, Waterside and Grand Manan. The dominant structure of the area is a syncline defined by the 'curved cuesta' of Cape Split, where the North Mountain Basalt dips 5 to 15 degrees towards the synclinal axis. The southern portion of the Bay is covered by Late Triassic sediments of the Scots Bay Formation. Triassic volcanics occur from near Cape Chegnecto past Isle Haute and Quaco Ledge. North of this ridge the Triassic sediments have not been definitely identified, but may be composed of the Blomidon Formation (Fig. 1).

A zone of discontinuous faults, parallel to the structural axis of the Triassic basin, separate the Triassic sediments from Carboniferous strata in the northwest portion of the Bay. The zone is similar to the 'Fundian Fault' suggested by Johnson (1925), but generally lies further offshore than its earlier postulated position.

The Fundy Triassic sediments extend from the Bay of Fundy into the northeast Gulf of Maine, where they are found in three narrow troughs in the older basement rocks.

King and MacLean (1976) have introduced the term 'Glooscap Fault' which includes the Cobequid-Chedabucto system and its possible extension along the Orpheus Basin, as well as a fault that followed Triassic volcanics from Cape Chegnecto past Isle Haute and Quaco Ledge and into the Gulf of Maine.

Gravity

The gravity field of the Bay of Fundy is similar to that observed east of Chedabucto Bay where the Orpheus anomaly, a zone of negative gravity, is flanked on both sides by positive values (Fig. 14). The same pattern is seen in the Bay, although it is not as intense as that observed near the Orpheus anomaly and may represent a similar structure to that seen on the Scotian Shelf.

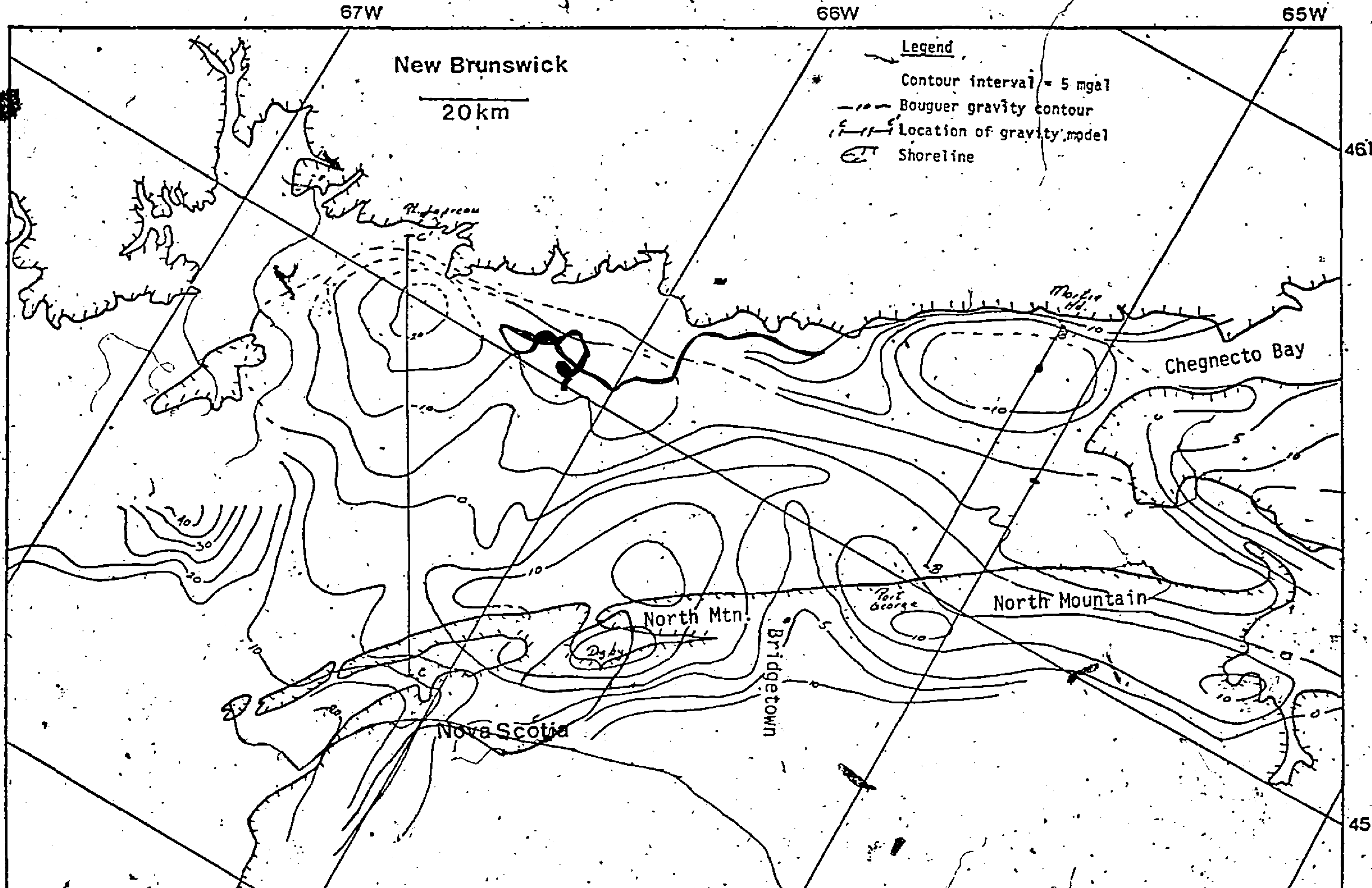

Fig.27 Bouguer gravity - Bay of Fundy, showing location of gravity models.

Measurements of the gravity field show that the formations on the south shore of the Bay of Fundy extend under the Bay, where they are overlain by Triassic rocks similar to those on shore. A zone of high gravity values runs parallel to North Mountain, coincident with rocks of the Meguma Group (Fig. 27). This gravity high extends into the Bay where the field associated with it is lost in the lower field of the sediments. Near Bridgetown, the Triassic sediments are seen to overlie an outcrop of Devonian granite. The low gravity field associated with the granite extends into the Bay. The gravity high associated with rocks of the Meguma Group surrounds the low associated with the granite and separates it from the low caused by the Triassic sediments. Presumably the granite and Meguma strata extend into the Bay in the same sequence observed on land.

The zone of high gravity found on the north shore of the Bay is coincident with occurrences of Precambrian strata that extend along most of the Bay from Saint John to Chegnecto Bay. These highs usually terminate at the coast, indicating that the basement strata are not as near surface as observed on the south shore. This agrees with the theory that the Bay is the site of a faulted half graben, with the faults occurring near the New Brunswick shore.

Two zones of gravity values much lower than those found elsewhere in the Bay are located near the coast of New Brunswick, at Pt. Lapreau and Martins Head. These are north of the Glooscap fault in the Bay, giving support to the theory that the fault is the site of a major break in the tectonic styles of the area.

Model studies were made over these lows to test the interpretation based on a sedimentary basin of low density Triassic and Carboniferous strata.

Profile B-B' Port George to Martins Head

The gravity anomaly for this profile shows a general decrease from the high observed over the Meguma rocks of Nova Scotia to the low near the New Brunswick coast (Fig. 28). A break in the trend occurs at the Triassic volcanics found in the centre of the Bay. This could be caused either by a rise in the basement under the Triassic strata, or by a large accumulation of volcanic material under the ridge. The latter seems less likely since the exposures of Triassic volcanics in the area are of uniform thickness. The model of the structure (Fig. 28) shows a syncline of Triassic sediments and volcanics in the older rocks which extend under the Bay and a trough of Carboniferous and Triassic sediment near New Brunswick. The surface structures, such as the location of the synclinal axis and the position of faults and boundaries, are as shown by King and MacLean (1976). Structures at depth were determined from projections of the observed dip and thickness of features on shore.

A study of the magnetic data for the area (Fig. 8) shows a change in the field on opposite sides of the Triassic volcanics. The magnetic field around Port George increases towards the volcanics (Fig. 28). At the volcanics the anomaly is characteristic of a dyke or a fault, while further north the magnetic values are higher than the general area background. The higher anomaly found near Martins Head is similar to that over exposures of Carboniferous strata in the Minas Basin. The low gravity and higher magnetic anomaly in the area suggests a zone of Carboniferous strata overlain by a cover of Triassic sediment. The long wavelength magnetic anomaly associated with the material in this basin is terminated upon contact with outcrops of Precambrian strata along the coast of New Brunswick. South of the volcanics, the anomaly is due to Triassic sediments in the Acadian Triassic Basin, indicating that there is no deviation from this structure.

The structures determined for the profile were based on the densities shown in Fig. 28, and are correct within a modelling error of 1 mgal RMS between the observed and theoretical anomalies. More precise knowledge of the actual densities involved will allow a more accurate estimate of the thickness of the different strata in the area.

Profile C-C': Digby to Point Lapreau

This area also shows a gradient in the gravity from south to north (Fig. 27). A gravity anomaly of approximately 15 mgals is observed over exposures of Meguma material near Digby; this decreases fairly uniformly toward the north side of the Bay, where an anomaly of less than -20 mgals is observed east of Grand Manan.

The magnetic field (Fig.8) across this area shows the same general characteristics as the rest of the Bay of Fundy. There is a general increase in the level of the field from south to north up to the position of the volcanics in the centre of the Bay. North of the volcanics we find a series of anomalies of higher frequency than in other portions of the Bay. King and MacLean (1976) have mapped the area coincident with the gravity low and these high frequency magnetic anomalies as 'structurally disturbed', on the basis of seismic reflection data that show numerous faults and folded beds.

The gravity low east of Grand Manan is basically confined to the area north of the volcanics. Due to a lack of information on the lithology and structure available in the area of the gravity low, it has been modelled as a basin filled with undifferentiated Carboniferous and Triassic sediment. This low marks the end of the lower gravity field found in the Bay of Fundy and, presumably, the deeper basement found there. Triassic sediments have

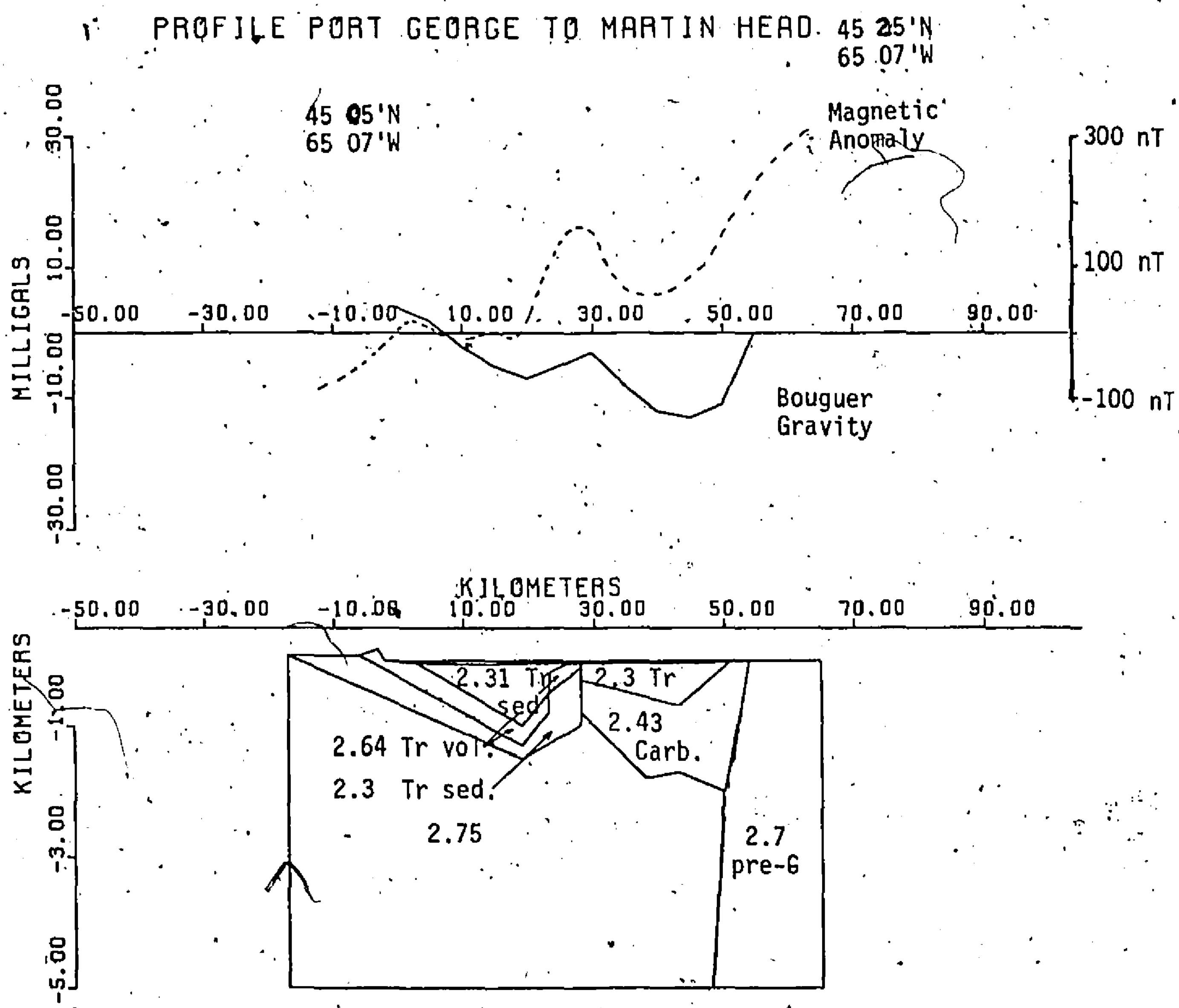

Fig.28 Gravity model over profile B-B',Port George to Martin Head

been traced into the Gulf of Maine, although the gravity field there is approximately 20 mgals higher than that in the Bay, due to a shallower basement in the Gulf.

The gravity low seen east of Grand Manan represents the greatest depth to basement in the Bay of Fundy. When compared to the gravity anomaly of 43 mgal observed over an outcrop of pre-Pennsylvanian basement south of Grand Manan, it is clear how large the contrast is between the depth to basement in the Bay and the Gulf. Assuming the basement outcrops south of Grand Manan, a depth of 0.2 km is indicated for the causative formation there. Anomalies of this magnitude are usually caused by outcrops of mafic rock with densities in the neighbourhood of 2.8 gm/cm^3. Using eq. (3) and a density contrast of 0.4 gm/cm^3 between the material south of Grand Manan and that in the area of the gravity low, a depth of 4.2 km is indicated for the basement under the low near Pt. Lapreau.

A steep gradient is observed to the north of the gravity low, suggesting that the low density strata may be in fault contact with the early Paleozoic strata found at the coast of New Brunswick.

Mouth of the Bay of Fundy

Near Grand Manan the Triassic strata of the Bay of Fundy are split into three basins by outcrops of pre-Pennsylvanian acoustic basement (Fig. 15). The basement outcrops are in the form of shallow banks with irregular surface topography and generally have a series of high frequency magnetic anomalies and gravity highs associated with them. This combination of topography, gravity and magnetic characteristics and the difference in acoustic properties observed over the outcrops of basement strata make detection of the older strata fairly certain.

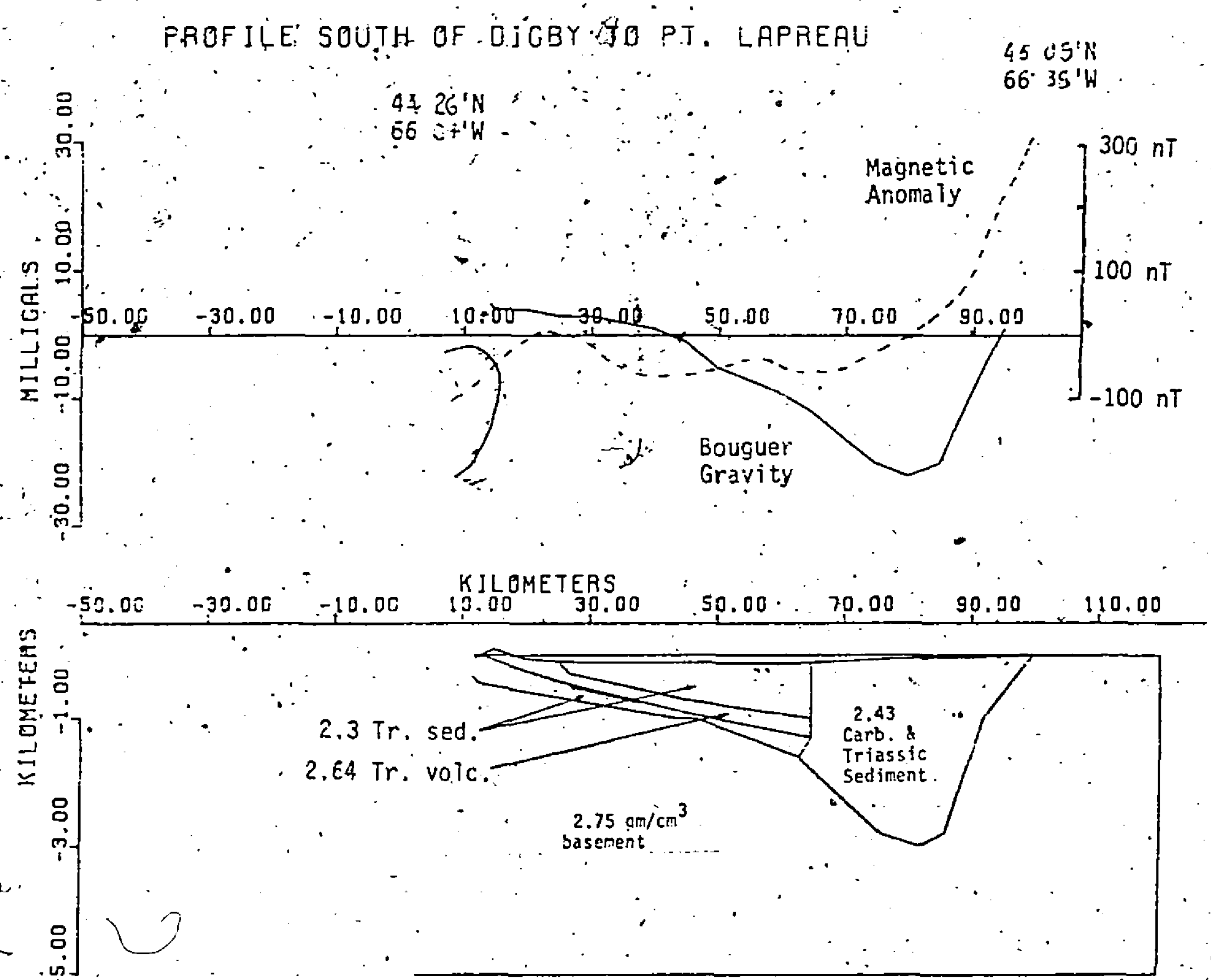

Fig.29 Gravity model over profile C-C', south of Digby to Pt.Lapreau

Outcrops of pre-Pennsylvanian basement usually have a gravity anomaly of 40 mgals associated with them, while Triassic strata in the area show a lower gravity level, although it is still higher than that found in the Bay. It would appear that the older basement rocks in this area were uplifted relative to the sedimentary strata in the Bay of Fundy, resulting in a greater depth to basement in the Bay. The uplift probably occurred along the northwest trending fault or the eastern edge of Grand Manan Bank (Fig. 15), where there is a change in the character of the magnetic field and an increase in the level of the gravity field. Further evidence may be observed on Grand Manan Island, which shows a faulted section of Precambrian strata in contact with an exposure of Triassic volcanics.

King and MacLean (1976) show a boundary of the magnetic field in the Gulf of Maine coincident with an outcrop of pre-Pennsylvanian basement dividing the Acadian Triassic Basin into two halves (Fig. 15). South of this boundary we find the same geological sequence observed in the Bay of Fundy. The basement under the Triassic is shallower than that found in the Bay, resulting in a gravity field that is approximately 20 mgal higher than that observed over the Triassic sediments in the Bay (Fig. 9).

Triassic strata are also present in troughs north of the boundary, separated by basement highs. The gravity field there is generally higher than that found to the south, which may be caused in part by a zone of dense strata found under the Triassic in the basins (Section 4.4, p. 44).

The boundary seems to be the location of a change in the tectonic styles, similar to that seen in the Bay. South of the boundary Triassic sediments rest on the Meguma basement while north of the boundary, there appears to be another formation between the Triassic strata and the magnetic basement.

Chapter 5. Summary and Conclusions

Summary

Data collected in the Bay of Fundy and Gulf of Maine show significant differences in the geophysical fields present over different portions of the survey area. Sufficient control has been provided to extend some features into the offshore regions of Nova Scotia and to suggest boundaries between areas of different geological history.

Most of the potential field anomalies in the region west of Nova Scotia can be traced back to shore and correlated with a corresponding anomaly, showing that the region of the Gulf of Maine near Nova Scotia has basically the same structural trends and lithological units found on the adjacent land. However, not all the data may be explained as simple continuations of the onshore geology.

The interpretation of structure for this area presented by Drake et al (1954), on the basis of seismic refraction data, gives an oversimplified picture of the actual structure. Recent potential field data allow a refinement of the structures shown by the seismic data and show that the geological features found onshore from Cape St. Mary to Yarmouth may extend to the area of the seismic profile. Where the seismic interpretation produced a single trough of Goldenville strata in the basement, gravity and magnetic data indicate the presence of three smaller troughs. The strata in these troughs vary in age from Ordovician to Tertiary.

The first trough (Zone B) is an offshore extension of the rocks and structure found near Yarmouth (Fig. 30). Linear magnetic anomalies observed in that vicinity may be traced offshore, where they change strike from a northeast to a north-south direction. Magnetic data over the area show changes in trend and possible faults, but a detailed study of structure is not possible due to data gaps and a lack of gravity and seismic data. Extrapolation of the marine gravity data onshore shows a gradient from the extremely high values found in the offshore regions near Nova Scotia to the low values over exposures of granite, indicating that the granite may extend into this region under the trough of Halifax strata. Since it is not possible to separate the anomaly caused by the Halifax Formation from that of the granite, any interpretation of the structure becomes highly speculative.

The linear magnetic trends observed over the Halifax Formation continue south to 43°20'N, where they are offset along a linear magnetic trend and finally disappear over the area where a continuation of the granite seen near Cape Sable is thought to exist.

The central trough (Zone A) is located at the point of greatest depth shown by the seismic refraction profile and appears to be a syncline in the Goldenville strata, filled with rocks of the Halifax and White Rock Formations, which are overlain by sediments of probable Triassic and Tertiary age. The syncline is flanked on both sides by outcrops of Goldenville strata and represents a probable extension of the Halifax Formation seen near Cape St. Mary (Fig. 30).

The trough to the west (Zone C) appears to be a sequence of Carboniferous to Triassic strata overlying the Goldenville basement. This trough is terminated upon contact with a unit whose seismic velocity indicates that it may be part of the 'sub-basement' of the central portion of the Gulf of Maine. This structure drawn on the basis of a change in the

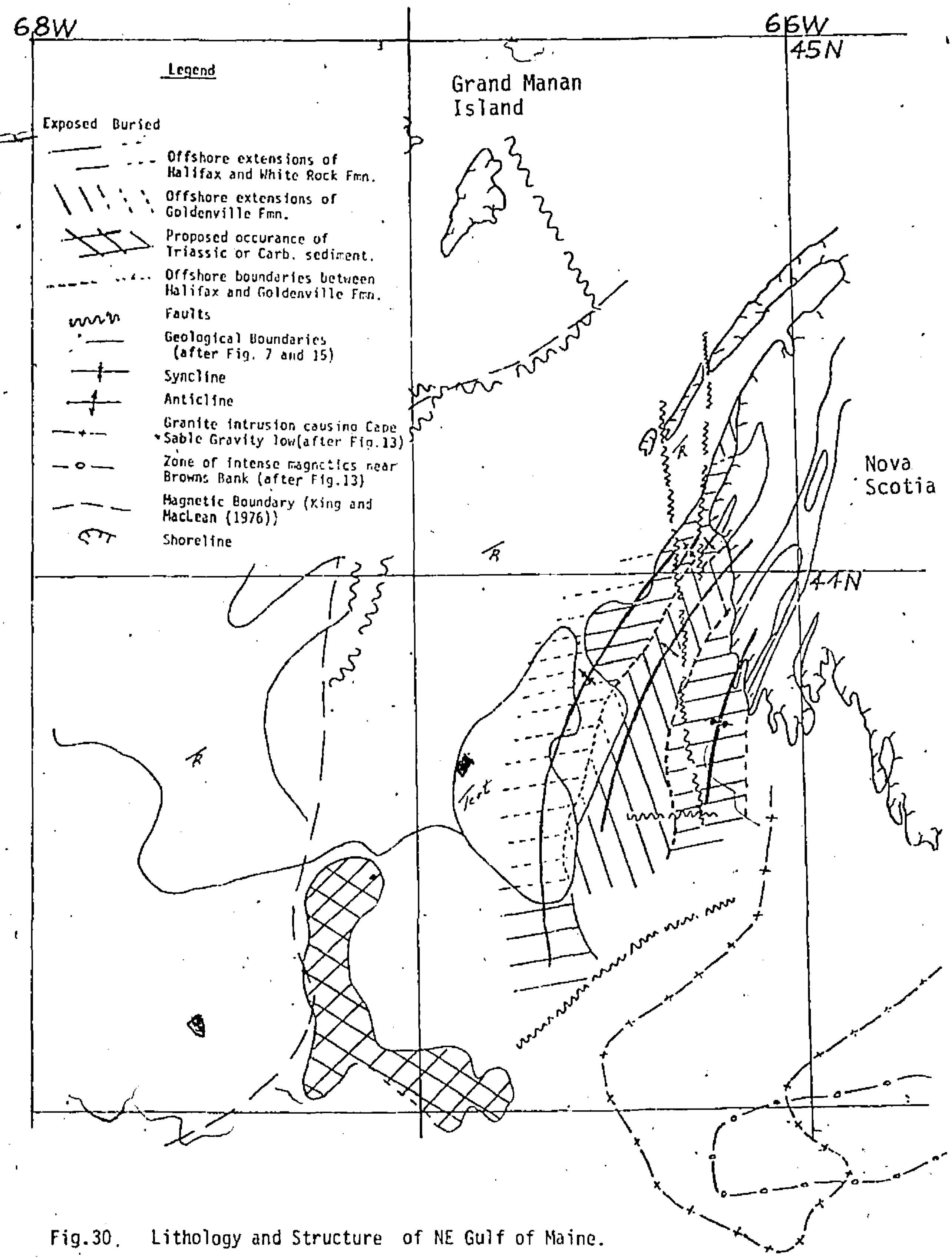

Fig.30. Lithology and Structure of NE Gulf of Maine.

character of the magnetic field, outcrops at the boundary between the deeper basement found in the region near Nova Scotia and the shallower magnetic basement of the interior of the Gulf (Kane et al (1972)). The boundary may represent the western limit of the extension of the Meguma Group into the Gulf. The overall geological sequence seen in this trough is similar to that at Cape St. Mary where Triassic sediments overlie the Goldenville Formation.

The gravity low observed southeast of Cape Sable is caused by granitic material similar to that found in western Nova Scotia and is probably an extension of that batholith. Depth to magnetic basement studies indicate the presence of a cover of relatively non-magnetic material over the granite, varying in depth from 0.2 to over 2 km. Since both the granite and the overlying formation are basically non-magnetic, the magnetic basement could be caused by an aureole of magnetic material due to metamorphism of the country rock, or by differentiation of the magma. Dredge hauls in the area show a predominance of granitic pebbles, suggesting that the granite may outcrop in the vicinity.

South of the Cape Sable gravity low, in a basin that forms the northern boundary of Browns Bank, there is a zone of high magnetic anomalies, similar to those seen over areas of volcanic material near Yarmouth. This zone persists over the entire length of the basin and terminates at its boundaries (Fig. 13). The basin and the associated magnetic anomalies are terminated by a linear scarp, which is probably an indication of faulting and which suggests that there is structural control of the topography of the area.

Data over Browns Bank do not allow for a detailed analysis of the structure or formations present. A rather deep magnetic basement is found across the Bank, generally greater than 1 km and with a maximum of over 6 km in one location. Gravity data over this zone are dominated by the gravity gradient observed over the contact between the granite, which causes the Cape Sable gravity low, and the surrounding country rock. A sedimentary cover of Tertiary material over the outer portion of the Bank lies upon rocks of the Meguma Group which probably form the bedrock of Browns Bank.

Gravity and magnetic data show that there may be slight differences in tectonic styles in the Bay of Fundy on the north and south sides of the Glooscap fault system. To the south of the fault the structure represents a continuation under the Bay of the Meguma rocks and Devonian granite found in western Nova Scotia. Carboniferous strata overlie the Meguma in the northern portion of the Meguma Platform from the Portipique fault (located 30 km south of the Chedabucto fault) almost to the location of North Mountain (Fig. 1). They are not found southwest of this location in Nova Scotia. The Triassic strata south of the Glooscap fault probably rest unconformably on the older Meguma strata. The older Carboniferous sediments, if they were ever present, have been eroded away. To the north of the fault sediments of Carboniferous age are present along most of the shoreline of New Brunswick, in contact with the predominantly Precambrian strata of the area. Carboniferous strata have been mapped under the Triassic sediments of the Bay (Swift and Lyall (1968 a and b)) and may form much of the material present in the gravity lows near Pt. Lapreau and Martins Head.

The region of the mouth of the Bay of Fundy represents an area of uplift of the older basement rocks. A shallower basement in the northern part of the Gulf of Maine than in the nearby Bay of Fundy is reflected by the lower values observed for the gravity field of the latter. The boundary of this zone of uplift appears to coincide with a northeast trending fault east of Grand Manan (Fig. 30). Southeast of this fault we find the higher gravity field characteristic of the Gulf. The south margin of Grand Manan Bank, a portion of the uplifted basement, is coincident with the boundary drawn by King and MacLean (1972) on the basis of a change in the magnetic field. North of this boundary the Triassic sediments appear to be underlain by a denser, non-magnetic rock, while south of the boundary the basin is filled with rocks having a density similar to the Triassic sediments of the Bay of Fundy. This boundary may represent the northern extent of the Meguma Group into the Gulf of Maine.

Triassic sediments, extending into the Gulf of Maine to within 70 km of Yarmouth, overlie rocks of the Halifax and possibly the White Rock Formations. The Triassic rocks in this area represent an extension of the sequence in the Bay of Fundy and show that the depositional and erosional history in these areas has been generally similar since early in Triassic time.

Conclusions

More detailed surveys of the Bay of Fundy and Gulf of Maine are needed to make a comprehensive interpretation of the geology of the area. The Meguma Platform of Nova Scotia has different geophysical characteristics than the rest of the Atlantic Provinces, which may be an indication of a different geological history for the Meguma Platform. Data were insufficient to determine the effect that continental drift has had on the area.

The variety of data types that were used in this interpretation shows the need for performing a number of different geophysical surveys when gathering information in an area. Gravity and magnetic data were used to interpret the regional geology of the area. Significant changes in the gravity field usually represented a major change in the lithology or structure. Local anomalies did not mask regional trends and allowed the gravity data to be used for correlation of geology across widely spaced survey lines. Magnetic data were also used for regional interpretation but were more susceptible to masking of regional trends by local anomalies, and were therefore more beneficial when used to add detail to the gross geology interpreted from the gravity data. Seismic reflection data provided information about the location of geological contacts and the structure of the sea floor. Bathymetry data were used in conjunction with gravity and magnetics to correlate changes in topographic relief with changes in the potential fields of the rocks of the area, and helped to identify some formations.

Further work should be done to improve the quality and quantity of the available data for the area. Gravity and magnetic data are required to allow a more complete interpretation of the regional field, to map the approximate position of geologic boundaries and to provide information on the sub-surface structure of the area. Seismic reflection data are required to provide the near surface structure which would not be evident in gravity or magnetic measurements, and to precisely locate the position of geologic boundaries implied by the potential fields. Core samples should be taken on both sides of any identified geologic boundaries to positively identify the lithologic units involved.

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APPENDIX A

Listing of the computer program TAL15,used to calculate the gravity field produced by the postulated structures.

```
COSY V3.2    - MSOS V4.2     25/02/75
 TAL15     DECK/       I=01,H=02,C=30,L
      PROGRAM TAL15
C     VERSION OF JULY 16,72 WITH TIMEING AND OUTPUT OF Z(K) FOR EACH ITER
C       VERSIC N OF JUNE 4 74 MOD FROM AUG 14,72 CHANGEING INCCORECT DIMEN
C       VERSICN OF JUNE 26,1972 FOR CDC 1350
C   TALPLOT 15 FROM TALPLOT 14 ON OCT 23,1970 BY WPOLINSREE
C     THIS IS A PROGRAM TO SO BOTH LAND AND SEA DATA
C    ELEVATICN MUST FOLLOW OGA DAT , BEGINNING WITH A NEW CARD IN FORMAT
C        5F10.2
C            FOR USE ON SIGMA 7,    7 TRACK MAGNETIC TAPE
C               OUTPUT REPRODUCES INPUT AND ALSO RESULTS
C
C     ASSIGN 9 TRACK MAG TAPE TO UNIT NUMBER 2
C LAST BODY POINT IN EACH POLYGON MUST HAVE A 9 IN COL 21
C    WEIGH EXPECTS THE DIMENSION OF X,Z, TO BO BE 3 .GT. THE =OF POLY
C      POINTS
C
C                LNO=1  SHOULD BE FOR WATER LAYER ONLY
C                IF LNO=1, THEN  2-D BOUGUER ANOMALY IS CALULATED.
C
C          ISW(1)=0     WRITE JTAPE
C                =1   NO WRITE JTAPE
C
C          ISW(2)=0   SETS ELEV      =0
C                =1     READS IN ELEV    IN    KM
C                =2     READS IN ELEV    IN    METERS
C
C          ISW(3)=0        PRCNTS INTERMEDIATE DATA FOR EACH PLOYGON
C                =1     NO PRITOUT OF INTERMED DATA
C
C          ISW(4)=0     PLOT INTERMEDIATE DATA
C                =1      NO PLOT
C
C          ISW(5)=0    NO PLOT OF ELEVATION
C                =1     PLOT ELEVATION
C       ISW(6) =1   TO ADJUST LAST CURVE TO FIT GRAVITY DATA
C     SSW(7) UP FOR OUTPUT DURING DEBUGING ONLY
C
C       ISW(9)   =1 TO NOT WRITE INTERMEDIATE DATA FOR EACH POLYGON ONTO
C           JTAPE ( NOT USED UNLESS ISW(1)=0)
C       SSW(11)=1 IF THERE IS ANOTHER SET OD
C      SSW(11) .EQ.1 IF THERE IS ANOTHER SET OF POLYGON
C      DATA TO B(      COMPUTES
C
C      SSW(12) UP TO USE ELEVATION VALUES IN CRUSTAL WT CALCULATION
C     THIS SHOULD BE USED WHEN THE GRAVITY ANOMALIES ARE BOUGUER ANOMALIE
C        AND THUS THE TOP OF THE MODEL IS AT SEA LEVEL.  A DENSITY OF  2.
C      IS USED IN  AKING THE WT CORRECTION
C     SSW(13) =1 TO OUTPUT RESULTS OF INPUT POLYGONS BEFORE
C      ALTERING THE VARIABLE BOUNDARY POINTS
C       THE POLYGON THAT IS TO BE VARRIED MUST BE THE LAST POLYGON TO BE
C     THE POINT TO BE VARRIED MUST NOT BE THE FIRST OR LAST POINT IN THE
C       POLYGON
C     THE LAYER TO BE VARRIED MUST LIE ON THE UPPER SURFACE OF THE
C       LAST POLYGON
C       SSW(14) =1 TO NOT PLOT WEIGHT CURVE
C       SSW(14) = 2 TO SUPRESS PLOTING OF WEIGHT AND GRAVITY CURVES
C       SSW(15)=1 FOR OUTPUT OF LL PARAMERS FOR EACH ITERATION(SSW13) MUS
C       ALSO BE SET =1 IF THIS OPTION IS SELECTED
C.      SSW(17)=1 TO PLT REFX=-1000.  (MUST PUT OGA(1)=0.,REFX=-FXI ON
C       INPUT
```

```
C        SSW(19) = 1 TO EXECUTE THE MODEL CHANGE LOOP FOR IMAX ITERATIONS
C        REGARDLESS OF THE CHANGE IN THE RMS ERROR
C        SSW(20)=1 TO READ IN VALUES OF FX(I),OGA(I), ONE SET OF
C        VALUES TO A CARD IN FORMAT 2F10.5)
C      IMAX IS THE MAXIMUM NUMBER OF MODELS THAT WILL BE CALCULATED.
C     IMOD IS THE NUMBERR OF MODELS THAT HAVE BEEN CALCULATED
C
         COMMON EXXX,ZEEE,SDELZ,DELZ,IDUM
        COMMON          COME( 5 ),FX(150),FZ(150),PDELZ(150)
       * ,X0(1),X(150),Z0(1),Z(150),OGA(150),TEST(150),DSU(150),AUX(20),
       * SUM(150),D GI(150),PCON(150),SUMW(150)              ,STSUM(150)
        DIMENSION LABEL(20),SSELZ(150),RESA(150),OGGA(150),ARRAY(150,4)
         DIMENSION HFDEL(15) ,XS(15)
         DIMENSION IALTE(150),AA(150  ),KK(5),D(5) ,DDELZ(20)
        EQUIVALENCE (ARRAY(1  ),SSELZ(1)),(ARRAY(151),RESA(1)),(ARRAY(301
       *),OGGA(1))
         DATA (D=0.,0.,0.,0.,0.)
   2     CONTINUE
C
C       INPUT OUTPUT UNIT ASSIGNMENT
C        CARD READER
         IIN=60
C        LINE PRINTER
         IIOUT=61
C       MAG TAPE OUTPUT
         JTAPE=2
C
         IMOD=0
         IFIRST=0
         IREST=0
         ILOOP=0
         MCH=14
         KFXN=1
         L=99
         KK(1)=-1
         KK(2)=0
         KK(3)=1
         KK(4)=0
         KK(5)=-1
C      ZEROING COMMON
         DO 1 K=1,1950
   1     COME(K)=0.
         SREFC=0
         RSQ=1.E70
         DEL=.15
         D(2)=-DEL
         D(4)=DEL
        TWDEL=2.*DEL/0.637
         N4=3
C     NOTE THAT THE LAST POLYGON MUST HAVE NUMBER 99
C        RDENS =REFERENCE DENSITY FOR GRAVITY CALCULATIONS
C     RWGT = REFERENCE WEIGHT FOR MASS CALCULATIONS
C        RHOD=DIFFERENCE DENSITY FOR MODEL ADJUSTING =RHO LOWER)-RHO(UPPER
         READ(IIN,446) (LABEL(KU),KU=1,20)
         WRITE(IIOUT,447) (LABEL(KU),KU=1,20)
         I=ISW(-2)
         IF(ISW(1).EQ.0) WRITE(JTAPE,446) (LABEL(KU),KU=1,20)
         DO 56 K=1,20
  56     IALTE(K)=ISW(K)
         IF(ISW(1).EQ.0) WRITE(JTAPE,419) (IALTE(K),K=1,20)
         READ (IIN,427) RDENS,RWGT,RHOD,REFX,FXI,DELFX,M       ,IMAX
         WRITE(IIOUT,4770) RDENS,RWGT,RHOD,REFX,FXI,DELFX,M     ,IMAX
```

```
      IF(ISW(1).EQ.0) WRITE(JTAPE,427) RDENS,RWGT,RHOD,REFX,FXI,DELFX,M
     * ,IMAX
      DO 59 I=1,M
      SUM(I)=0.
      TEST(I)=0
      DSU(I)=0
   59 CONTINUE
      FX(KFXN)=FXI
      FZ(KFXN)=0.0
      K1=KFXN+1
       IF(ISW(20).NE.1) GOTO48
       READ(IIN,42) (FX(I),OGA(I), I=1,M)
       GOTO49
   48 READ200,(OGA(I),I=1,M)
   49  DO 620 I=1,M
       OGGA(I)=OGA(I)
       IF(OGA(I).GE.899.) OGGA(I)=0.
  620  CONTINUE
      IF(ISW(1).EQ.1) GO TO 7004
      WRITE (JTAPE,200) (OGA(I),I=1,M)
 7004  CONTINUE
       IF  (ISW(2).EQ.0) GO TO 7021
       READ201,(FZ(I),I=1,M)
      IF(ISW(1).EQ.1) GO TO 7005
      WRITE(JTAPE,  201) (FZ(I),I=1,M)
 7005 CONTINUE
       CC= 1.
       IF(ISW(2).EQ.2) CC=1000.
      DO 7034 I=1,M
       FZ(I)=-FZ(I)/CC
      ARRAY(I,4)=FZ(I)*(-100.)
 7034 CONTINUE
 7021 CONTINUE
       IF(ISW(20).EQ.1) GOTO95
      DO 451 K=K1,M
  451 FX(K)=FX(K-1)+DELFX
   95 DO 96 K=KFXN,M
      SSELZ(K) = 0.0
   96 CONTINUE
      DO 53J=KFXN,M
      IF(REFX-FX(J))53,21,53
   53 CONTINUE
   21 J=J
       IF(ISW(17).EQ.1) J=1
       IF(ISW(17).EQ.1) FX(1)=-1000.
      REFOGA = OGA(J)
       JREF=J
   60  CONTINUE
       READ(IIN,433) LNO,RHORK,COME
       WRITE(IIOUT,45) LNO,RHORK,COME
       IF(ISW(1).EQ.0) WRITE(JTAPE,433) LNO,RHORK
      RHO=RHORK-RDENS
  799  CONTINUE
      I=1
  801 READ 442 ,XX,ZZ  ,ICODE ,IAL
      X(I)=XX
      Z(I)=ZZ
       IALTE(I)=IAL
      PRINT 7032,X(I),Z(I),ICODE ,IAL
      IF(ISW(1).EQ.1) GO TO 7008
       IF(IREST.EQ.1) GOTO 7008
      WRITE(JTAPE,442)X(I),Z(I),ICODE,IAL
```

```
 7008 CONTINUE
      N=I
      I=I+1
      IF(ICODE-9)801,810,801
810    CONTINUE
       IF(IREST .EQ.1) GO TO 811
      CALL WEIG2 (X,Z,N,FX,M,SUM,RHORK,TEST,DSU)
811    CONTINUE
       IF(ISW(3).EQ.0) PRINT 47
C
C      FIELD POINT DO LOOP
C
      DO 421 K=KFXN,M
      SDELZ=0.
C
C      POLYGON POINTS DO LOOP
C
      DO 3004I=1,N
       IDUM=I
  205 FXXX=X(I) - FX(K)
      ZEEE=Z(I) - FZ(K)
       CALL COMP
 3004 CONTINUE
      IF(ILOOP.EQ.1)GOTO3005
      PDELZ(K)=13.34*RHO*SDELZ
      GOTO 3008
3005   CONTINUE
      PDELZ(K)=RHOD*(13.34*SDELZ-PCON(K)/RHO )
3008  CONTINUE
      SSELZ(K)=SSELZ(K)+PDELZ(K)
       IF(LNO-1)4101,5001,4101
5001     BGTD=BGA(K)+PDELZ(K)*(2.67-RHORK)/RHO
 5006  PRINT 5007,K,FX(K),FZ(K),PDELZ(K),BGTD
C
C     TO WRITE COMPLETE BOUGUER ANOMALY ON JTAPE
C
       IF(ISW(1).EQ.1)   GO TO 7009
       WRITE(JTAPE,5007)K,FX(K),FZ(K),PDELZ(K),BGTD
        GO TO 7009
 4101 CONTINUE
      IF(ISW(3).EQ.1) GO TO 7022
      PRINT44,K,FX(K),FZ(K),PDELZ(K)  ,DSU(K)
 7022 CONTINUE
       IF(ISW(9).EQ.1) GO TO 7009
       IF(ILOOP.EQ.1) GO TO 7009
      IF(ISW(1).EQ.1) GO TO 7009
       IF(IREST.EQ.1) GOTO 7009
       WRITE(JTAPE,44)K,FX(K),FZ(K),PDELZ(K)
 7009 CONTINUE
  421 CONTINUE
      IF(ISW(4).EQ.1) GO TO 423
       CALL PLOTB(4,PDELZ,150,1,M,0.,0.)
423   CONTINUE
      IF(L-LNO) 60,430,60
  430  REFCOR = REFOGA-SSELZ(J)
      DO   422K=KFXN,M
      SSELZ(K) = SSELZ(K) + REFCOR
422    CONTINUE
       SREFC=SREFC+REFCOR
       IRES=0
       RSOLD=RSQ
       RSQ=0
```

```
      RESF=0
C
C     CALCULATING THE RMS ERROR
C
      DO 4422 K=KFXN,M
      IF(   OGA(K).GE.900) GOTO 4422
      RESA(K)=SSELZ(K)-OGA(K)
4422  CONTINUE
      DO 4424 K=KFXN,M
      IF(OGA(K).GE.900) GO TO 4424
      IRES=IRES+1
      RSQ=RESA(K)**2+ RSQ
 4424 CONTINUE
      RSQ=SQRT(RSQ/IRES)
      WRITE(IIOUT,4425) IMOD,RSQ,IRES
      IF(IMOD.GT.IMAX ) GO TO 438
      IF(ISW(15).EQ.1)      IFIRST=0
      IF(ISW(13).EQ.1 .AND. IFIRST.EQ.0) GOTO 439
4423  CONTINUE
      IFIRST=1
      IF(ISW(19).EQ.1) GOTO4427
      IF(ISW(6).EQ.0 .OR.IMOD.GT.IMAX) GOTO438
     IF(( RSQLD-0.5).LT.RSQ .AND. IMOD.GT.1) GOTO438
C    BRANCHING OUT OF MODEL ALTERING PART OF M PROGRAM
4427   CONTINUE
     KQQ=(MCH*(MCH+1))/2
     DO 4426 LQ=1,KQQ
4426 AA(LQ)=0.
      XO(1)=X(N)
      ZO(1)=Z(N)
      K=JREF
      MCH=0
C
C    COMPUTATION OF U/DZ FOR THE REFERENCE POINT
C
     NLQ=N-1
      DO 7650 I=1,NLQ
      IF(IALTF(I).EQ.0) GO TO 7650
      SDELZ=0.
      DO 7640 IDUM=1,5
      II=IDUM
      ARG=X(I+1)-X(I-1)
     KQ=I+KK(II    )
     EXXX=X(KQ        ) -FX(K)
      ZEEE=Z(KQ        )-FZ(K)+D(II)*SIGN(1.,ARG)
      CALL COMP
 7640 CONTINUE
      MCH=MCH+1
C
C     ZEROING XS
      XS(MCH)=0.
C
      RFDEL(MCH)=13.34*RHOD*SDELZ
7650  CONTINUE
      KCODE=0
      IF(ISW(7).EQ.1) WRITE(IIOUT,4701) KCODE,K, (RFDEL(KD),KD=1,MCH)
C
C    STORING THE OLD VALUES OF PDELZ
C
      IF(ILOOP.EQ.1) GO TO 434
      DO 432 K=KFXN,M
432   PCON(K)=PDELZ(K)
```

```
      GO TO 436
434   DO 435 K=KFXN,M
435   SSELZ(K)=SSELZ(K)-PDELZ(K)
C  SSELZ(K) IS NOW THE SUMMED VALUE OF ALL POLYGON CONTRIBUTIONS
C     EXCEPT THAT DUE OT THE CHANGED PART OF THE MODEL
      SREFC=SREFC-PDELZ(JREF)
436   CONTINUE
      ILOOP=1
      IMOD=IMOD+1
CC
C     FIELD POINT DO LOOP
C
      DO 7850 K=KFXN,M
      IF(OGA(K).GE.900) GO TO 7850
      IF(K.EQ.JREF) GO TO 7850
      MCH=0
C
C   COMPUTING D/DZ FOR EACH CHANGEABLE POLY POINT
C
      DO 7830 I=1,NLG
      IF(IALTE(I).EQ.0) GO TO 7830
     SDELZ=0.
      DO 7820 II=1,5
      ARG=X(I+1)-X(I-1)
     KG=I+NK(II)
      EXXX=X(KG      ) -FX(K)
      ZEEE=Z(KG      )-FZ(K)+D(II)*SIGN(1.,ARG)
      IDUM=II
      CALL COMP
 7820 CONTINUE
      MCH=MCH+1
      DDELZ(MCH)=13.34 *RHOD*SDELZ-RFDEL(MCH)
7830  CONTINUE
      KCODE=1
      IF(ISW(7).EQ.1) WRITE(IIOUT,4701) KCODE,K, (DDELZ(KD),KD=1,MCH)
C   NOW ADD THE CONTRIBUTION TO THE NORMAL EQUATION
C
      DO 7835 II=1,MCH
      DO 7834 IP=1,II
     KG=IP+((II-1.)*II)/2
     AA(KG)=AA(KG)+DDELZ(IP)*DDELZ(II)
7834  CONTINUE
     XS(II    )=XS(II   )+HESA(K)*DDELZ(II)
7835  CONTINUE
7850  CONTINUE
C   WE HAVE NOW FINISHED SETTING UP THE NORMAL EQUATIONS
     EPS=1.E-10
C
C
      MP1=MCH+1
     IDENT=10
      IF(ISW(7).EQ.1)   WRITE (IIOUT,4541) IDENT,(AA(II),II=1,KQ )
     IDENT=5
     IF(ISW(7).EQ.1) WRITE(IIOUT,4541) IDENT, (XS(II), II=1,MCH)
     CALL GELS(XS,AA,MCH,1,EPS,IER,AUX)
      IF (IER.NE.0) WRITE (IIOUT,44) IER
C     CALCULATE THE NEW VALUES OF THE POYGON POINTS
      MCH=0
      DO 7860 K=1,N
      IF(IALTE(K).EQ.0) GO TO 7860
      MCH=MCH+1
      Z(K)=Z(K)*(1.+0.637*ATAN(TWDEL*XS(MCH)/Z(K)) )
```

```
      IF(Z(K).LT.0.2) Z(K)=.2
7860  CONTINUE
      GO TC 811
438   CONTINUE
      IF(ILOOP.EQ.0) GO TO 439
C     MAKING THE WEIGT CALCULATION FOR THE MODIFIED POLYGON
C   AA IS JUST A GARBAGE ARRAY
      CALL WEIG2(X,Z,N,FX,M,AA, 1.   ,AA,DWGT )
      DO 441 K=KFXN,M
      IF(IREST.EQ.1) SUM(K)=STSUM(K)
      STSUM(K)=SUM(K)
C     STORING THE VALUE OF SUM TO USE IN FUTURE CALCULATIONW
441   SUM(K)=SUM(K)+(DWGT (K)-DSU(K)/RHORK)         *RHOO
C   DWGT(K) IS BEING USED FOR TEMPORARY STORAGE
     WRITE(IIOUT,4749)
4749 FORMAT(30H NEW POLY POINTS-FINAL VERSION )
      WRITE(IIOUT,440)(X(K),Z(K),K=1,N)
      IF(IREST.EQ.1) GOTO 4041
      IF(ISW(1).EQ.1) GOTO4041
      WRITE(JTAPE,42)  (X(K),Z(K), K=1,NLO)
     WRITE(JTAPE,442) X(N),Z(N),ICODE
4041  CONTINUE
439   PRINT 51
      DO 7000 K=KFAN,M
      DWGT(K)=SUM(K)-RWGT
      SSSSS=SSELZ(K)-SREFC
      IF(ISW(12).EQ.1)
    *  DWGT(K) =DWGT(K) +ARRAY(K,5)*2.67
      PRINT52,K,FX(K),FZ(K),SSSSS,SSELZ(K),RESA(K),OGA(K)
    1,SUM(K),DWGT(K) ,TEST(K)
483   CONTINUE
     IF(ISW(1).EQ.1) GO TO 7000
      IF(IREST.EQ.1) GOTO 7000
      WRITE(JTAPE,52)K,FX(K),FZ(K),SSSSS,SSELZ(K),RESA(K),OGA(K)
    1 ,SUM(K),DWGT(K)
7000 CONTINUE
4220     CONTINUE
     IF(ISW(1).EQ.1) GO TO 7013
      END FILE JTAPE
7013 CONTINUE
      IF(ISW(14).LT.1)
    *CALL PLOTH(LNO,DWGT,150,1,M,0.,0.)
      IF(ISW(5).EQ.1) N4=4
      IF  (ISW(14).NE.2)
    * CALL PLOTB(LNO,ARRAY,150,N4,M,0.,0.)
     WRITE(IIOUT,4753)
4753 FORMAT(41H 1=THEO,2=RESIDUAL,3=OBSERVED,4=ELEVATION)
    *  IF(ISW(13).EQ.1 .AND. IFIRST .EQ.0) GOTO 4423
999  CONTINUE
C   STORING THE VALUE OF X
      IF(ISW(6) .NE.1) GO TO 7011
      READ(IIN,433) LNO,RHONEW
      IF(LNO.NE.99) GO TO 7011
      IREST=1
      IMOD=0
      RSQ=1.E70
      DO 630 K=KFXN,M
630   SSELZ(K)=SSELZ(K)-PDELZ(K)
C  SSELZ(K) IS NOW THE SUMMED VALUE OF ALL POLYGON CONTRIBUTIONS
C     EXCEPT THAT DUE OT THE CHANGED PART OF THE MODEL
      GO TC 799
C    IREST IS SET EQUAL TO 1 TO INDICATE THAT
```

```
C  . WE ARE READING AN ADDITION SET OF POINTS FOR THE LAST
C     POLYGON  TO SEE THE EFFECT OF USING DIFFERENT
C     VARIABLE POLYGON POINTS
7011   CONTINUE
       IF(ISW(11).EQ.1) GOTO2
       STOP
10     FORMAT(8H TIME,Z  ,I10,(8E12.4))
 42    FORMAT(2F10.2)
  100  FORMAT(5F5.1)
 442   FORMAT(2F10.2,2I1)
   44  FORMAT(I5,4F10.2)
   45  FORMAT(//6H LNO =,I4,             10H      RHO =,F10.3,2X,5A4)
   47  FORMAT(/35H     K       FX(K)       FZ(K)     ANOMALY)
447    FORMAT(16H1TAL15-4JUNE74   ,5X,20A4)
419    FORMAT(80I1)
427    FORMAT(6F10.2,2I10)
446    FORMAT(20A4)
   51  FORMAT(/109H    K       FX(K)       FZ(K)     ANOMALY    CAL REF   RESIDUAL
     1   OBS ANOMALY           WEIGHT          WGT DIFF      WEIGHTEST   )
4541   FORMAT(I10,(10E11.3))
4770   FORMAT(7H RDENS=,F5.2,6H,RWGT=,F10.1,6H,RHOD=,F5.2,6H,REFX=,
      *F6.0,5H,FXI=,F6.0,7H,DELFX=,F6.3,3H,M=,I4,6H,IMAX=,I5)
200    FORMAT(5F10.1)
201    FORMAT(5F10.1)
433    FORMAT(I5,F10.3,5A4)
7032   FORMAT(2X,2F11.3,3X,2I1)
 5007  FORMAT(I5,4F10.2)
4425   FORMAT(2X,5HIMOD=,I5,8H,RMS ER=,F9.4,9H,NPOINTS=,I4)
4701   FORMAT(1X,2I2,(10E11.3))
440    FORMAT(2X,2F10.2)
  52   FORMAT(I5,6F10.2,F16.0,F16.0,F16.0,F6.1)
       END
       SUBROUTINE WEIG2(XPOL,ZPOL,NVERT,X,NPTS,SUM,RHO,TEST,DSU)
C      THIS IS VERSIONS 2 WHICH ALSO DOES WEIGHTEST
C      THIS SUBROUTINE IS TO BE USED WITH TALPLOT.  IT COMPUTES THE
C      DENSITY CONTRIBUTION OF A POLYGON OF DENSITY RHO AND ADDS THE
C      CONTRIBUTION TO THE SUM
C      XPOL, ZPOL ARE THE COORDINATES OF THE VERTICES OF THE POLYGON
C      NVERT IS THE NO OF VERTICES IN A POLYGON
C      X IS THE COORDINATEE AT WHICH WE WISH THE SM CALCULATED.
C      NPTS IS THE NO OF POINTS AT WHICH WE WISH THE SUM CALCULATED
C      SUM IS THE ACCUMULATED DENSITY CONTRIBUTION
C      A RESTRICTION IS THAT THE FIRST THREE(3) POINTS OF A POLYNOMIAL
C      MAY NOT HAVE THE SAME X COORDINATE.  THE FIRST TWO (2) MAY BE
C      THE SAME, AND AFTER THE FIRST VERTICE ANY NUMBER MAY
C      THE DIMENSION OF XPOL,ZPOL, MUST BE 3 GREATER IN THE MAIN PROGRAM
C      THEN THE ACTUAL NO OF VERTICES (NVERT)
       DIMENSION XPOL(1),ZPOL(1),X(1),Z(1),WT(1),SUM(1),NFLAG(10),
      1DIS(10),SORT(10),KFLAG(10),TEST(1),DSU(1)
       ZPOL(NVERT+1)=ZPOL(2)
       ZPOL(NVERT+2)=ZPOL(3)
       ZPOL(NVERT+3)=ZPOL(4)
       XPOL(NVERT+1)=XPOL(2)
       XPOL(NVERT+2)=XPOL(3)
       XPOL(NVERT+3)=XPOL(4)
       DO 300 I=1,NPTS
       SU=0.
       INTER=1
       IIOUT=61
       NDUM=NVERT+2
       JJ=3
       XX=X(I)
```

```
      DO 9 IQ=1,10
      DIS(IQ)=0.
9     NFLAG(IQ)=-1
      IF(XX-XPOL(3))11,15,80
15    JJ=2
      NDUM=NVERT+1
      IF(XX-XPOL(2))11,14,80
18     FORMAT (12H WEIGH2 ER1   )
14    JJ=1
      NDUM=NVERT
      IF(XX-XPOL(1))11,17,80
17    CONTINUE
      WRITE(IIOUT,18)
11    CONTINUE
12    JJ=JJ+1
      IF(JJ.GT.NDUM) GO TO 100
      IF(XX-XPOL(JJ))11,20,21
20    JAC=JJ
22    IF(XX.NE.XPOL(JJ+1)) GO TO 24
      JJ=JJ+1
      GO TO 22
21    DIS(INTER)=((XPOL(JJ)-XX)*ZPOL(JJ-1)+(XX-XPOL(JJ-1))*ZPOL(JJ))
     1/((XPOL(JJ)-XPOL(JJ-1)))
      INTER=INTER+1
      GO TO 80
C     THIS SECTION HANDLES INTERSECTION WITH A VERICAL
C     LINE OR INTERSECTION THRU ONE OF THE VERTICES OF THE POLYGON
24    IF(XPOL(JJ+1).GT.XX) GO TO 26
      IF(JJ.GE.NDUM) GO TO 100
      DIS(INTER)=(ZPOL(JJ)+ZPOL(JAC))/2.
      INTER=INTER+1
      GO TO 80
26    IF(JAC.EQ.JJ) GO TO 11
      DIS(INTER)=ZPOL(JAC)
      NFLAG(INTER)=INTER
      INTER=INTER+1
      DIS(INTER)=ZPOL(JJ)
      NFLAG(INTER)=INTER-1
      INTER=INTER+1
      GO TO 11
80    CONTINUE
      JJ=JJ+1
      IF(JJ.GT.NDUM) GO TO 100
      IF(XPOL(JJ)-XX)80,90,91
90    JAC=JJ
92    IF(XX.NE.XPOL(JJ+1)) GO TO 94
      JJ=JJ+1
      GO TO 92
91    DIS(INTER)=((XX-XPOL(JJ))*ZPOL(JJ-1)+(XPOL(JJ-1)-XX)*ZPOL(JJ))
     1/(XPOL(JJ-1)-XPOL(JJ))
      INTER=INTER+1
      GO TO 11
94    IF(XPOL(JJ+1).LT.XX) GO TO 96
      DIS(INTER)=(ZPOL(JJ)+ZPOL(JAC))/2.
      INTER=INTER+1
      GO TO 11
96    IF(JAC.EQ.JJ) GO TO 80
      DIS(INTER)=ZPOL(JAC)
      NFLAG(INTER)=INTER
      INTER=INTER+1
      DIS(INTER)=ZPOL(JJ)
      NFLAG(INTER)=INTER-1
```

```
      INTER=INTER+1
      GO TO 80
100   CONTINUE
C
C
C     WE HAVE NOW LOCATED ALL THE INTERSECTIONS WHICH RUN DOWN THE
C     BODY OF A POLYGON AND NEVER CROSS IN OR OUT
C     THE INTERSECTION WILL NOW BE SORTED FROM SMALLEST TO LARGEST
      INTER=INTER-1
C     THIS CHANGES INTER SO THAT IT NOW = THE NO OF INTERSECTIONS
      IF(INTER.EQ.0) GO TO 300
C     IF THERE ARE NO INTERSECTIONS WE BYPASS THE COPUTATION
C     OF THE SDISTANCE
C     SORT FROM SMALLEST TO LARGEST
      DO 112 IU=1,INTER
      JJU=1
      KFLAG(IU)=NFLAG(1)
      SORT(IU)=DIS(1)
      DO 110 JU=2,INTER
      IF(SORT(IU).LE.DIS(JU)) GO TO 110
      SORT(IU)=DIS(JU)
      KFLAG(IU)=NFLAG(JU)
      JJU=JU
110   CONTINUE
      DIS(JJU)=1.E70
112   CONTINUE
      SUBT=0.
      IF(SORT(1))2201,2202,2202
2201  CONTINUE
      DSOR=0.
      IF(SORT(2).LT.0)DSOR=SORT(2)
      SUBT=(SORT(1)-DSOR)
2202  CONTINUE
C     THE NC ARE ALL SORTED NOW
C     WE ARE NOW GOING TO COMPUTE THE SI DISTANCE
C
      MDID=0
201   IF(INTER-MDID)999,999,202
202   MDID=MDID+1
      IF(KFLAG(MDID))203,203,221
203   SU=SU+SORT(MDID+1)-SORT(MDID)
      IF(KFLAG(MDID+1))204,204,245
204   MDID=MDID+1
      GO TO 201
C     THIS HAS NOW HANDLED THE NORMAL SECTION
221   IF(KFLAG(MDID).NE.KFLAG(MDID+1)) GO TO 224
      SU=SU+(SORT(MDID+1)-SORT(MDID))/2.
      MDID=MDID+1
      GO TO 201
224   SU=SU+(SORT(MDID+3)+SORT(MDID+2)-SORT(MDID+1)-SORT(MDID))
     1/2.
      MDID=MDID+3
      GO TO 201
245   IF(KFLAG(MDID+1).NE.KFLAG(MDID+2)) GO TO 248
      SU=SU+(SORT(MDID+2)-SORT(MDID+1))/2.
      MDID=MDID+2
      GO TO 203
248   SU=SU+(SORT(MDID+2)-SORT(MDID+1)+SORT(MDID+4)-SORT(MDID+3))/2.
      MDID=MDID+4
      GO TO 203
999   SUM(I)=SUM(I)+RHO*SU*100.
      TEST(I)=TEST(I)+(SU+SUBT)*267.
```

```
      DSU(I)=SU*RHO*100.
300   CONTINUE
      RETURN
      END
       SUBROUTINE COMP
C     MODIFIED JULY 24 72 TO OUTPUT INTERMED RESULTS FOR DEBUGGING
C      IF ISW(16)=1
       COMMON EXXX,ZEEE,SDELZ,DELZ,IDUM
1      FORMAT( 5H COMP ,7E13.5,I5)
      RR=EXXX**2+ZEEE**2
       IF (ISW(16).EQ.1) WRITE (61,1) EXXX,ZEEE,SDELZ,DELZ,RR,R,ZEE,IDUM
      IF(EXXX)210,240,280
  210 IF(ZEEE)220,230,230
  220 THETB=ATAN(ZEEE/EXXX)-3.1415927
      GO TO 301
  230 THETB=ATAN(ZEEE/EXXX)+3.1415927
      GO TO 301
  240 IF(ZEEE)250,260,270
  250 THETB=-1.5707963
      GO TO 301
  260 THETB=0.
      GO TO 301
  270 THETB=1.5707963
      GO TO 301
  280 THETB=ATAN(ZEEE/EXXX)
301    IF(IDUM-1) 3001,3002,3001
 3001 CHECK=EXX*ZEEE-ZEE*EXXX
      IF(CHECK)320,310,320
  310 DELZ=0.
      GO TO 401
  320 OMEGA=THETA-THETB
      IF(OMEGA)3201,3202,3202
 3202 IF(OMEGA-3.1415927)330,330,340
 3201 IF(OMEGA+3.1415927)340,330,330
  330 DTHET=OMEGA
      GO TO 370
  340 IF(OMEGA)351,360,360
  351 DTHET=OMEGA+6.2831853
      GO TO 370
  360 DTHET=OMEGA-6.2831853
  370 A=CHECK/((EXXX-EXX)**2+(ZEEE-ZEE)**2)
      B=(EXXX-EXX)*DTHET
      C=0.5*(ZEEE-ZEE)*ALOG(RR/R)
      DELZ=A*(B+C)
  401 SDELZ=SDELZ+DELZ
 3002 EXX=EXXX
      ZEE=ZEEE
      R=RR
      THETA=THETB
       RETURN
       END
      SUBROUTINE GELS(R,A,M,N,EPS,IER,AUX)
C      PURPOSE
C             TO SOLVE A SYSTEM OF SIMULTANEOUS LONEAR ECAUATIONS WITH
C             SYMETRIC COEFICIENT MATRIX, UPPER TRIANGULAR PART OF WHICH
C             IS ASSUMED TO BE STORRRED COLUMNWISE.
C      USAGE
C
C             CALL GELS(R,A,M,N,EPS,IER,AUX)
C
C      DESCRIPTION OF PARAMETERS
C             R      -MBY N RIGHT HAND MATRIX (DESTROYED)
```

```
C              ON RETURN CONTAINES THE SOLUTION OF THE EQUATIONS
C           A    -UPPER TRIANGULAR OF THE SYMMETRIC M BY M
C                COEFICIENT MATRIX (DESTROYED)
C           M    -THE NUMBER OF EQUATIONS IN THE SYSTEM
C           N    -THE NUMBER OF RIGHT HAND SIDE VECTORS.
C           EPS -AN INPUT CONSTANT WHICH IS USED AS  RELATIVE TOLERANC
C                    FOR TEST ON LOSS OF SIGNIFICANCE
C           IER - RESULTING ERROR PARAMETER CODED AS FOLLOWS
C                IER=0  NO ERROR
C                IER=-1 NO RESULT BECAUSE OF M LEES THAN 1 OR PIVOT
C                ELEMENT AT ANY ELIMINATION STEP =0
C                IER=5  WARNING DUE TO POSSIBLE LOSS OF SIGNIGICANCE
C                       INDICATED AT ELIMINATION STEP K+1 WHRERE PIVOT
CC                   ELEMNT WAS LESS THAN OR EQUAL TO THE INTERNAL TOL
C                    TOLERANCE EPS TIMES ABSOULUTELY GREATEST ELEMENT
C                    OF MATRIX A
C           AUX - AN AUXILARY STORRAGE ARRAY OF DIMENSION M-1
CC     REMARKS
C           UPPER TRIANGULAR PART OF MATRIS A IS ASSUMED TO BE STORED
C           COLUMNWISE IN M*(M+1)/2 SUCCESIVE STROAGE LOCATIONS, RIGHT
C           HAND SIDE MATRIX R COLUMWISE IN N*M SUCCESIVE LOCATIONS.
C           ON RETURN SOLUTION MATRIX RVIS STORED CLOLUM WISE TOO.
      DIMENSION A(1),R(1),AUX(1)
      IF(M)24,24,1
1     IER=0
      PIV=0.
      L=0
      DO 3 K=1,M
      L=L+K
      TB=ABS(A(L))
      IF(TB-PIV)3,3,2
2     PIV=TB
      I=L
      J=K
3     CONTINUE
      TOL=EPS*PIV
      LST=0
      NM=N*M
      LEND=M-1
      DO 18 K=1,M
      IF(PIV)24,24,4
4     IF(IER)7,5,7
5     IF(PIV-TOL)6,6,7
6     IER=K-1
7     LT=J-K
      LST=LST+K
      PIVI=1./A(I)
      DO 8 L=K,NM,M
      LL=L+LT
      TB=PIVI*R(LL)
      R(LL)=R(L)
8     R(L)=TB
      IF(K-M)9,19,19
9     LR=LST+(LT*(K+J-1))/2
      LL=LR
      L=LST
      DO 14 II=K,LEND
      L=L+II
      LL=LL+1
      IF(L-LR)12,10,11
10    A(LL)=A(LST)
      TB=A(L)
```

```
      GO TO 13
11    LL=L+LT
12    TB=A(LL)
      A(LL)=A(L)
13    AUX(II)=TB
14    A(L)=PIVI*TB
      A(LST)=LT
      PIV=0.
      LLST=LST
      LT=0
      DO 18 II=K,LEND
      PIVI=-AUX(II)
      LL=LLST
      LT=LT+1
      DO 15 LLD=II,LEND
      LL=LL+LLD
      L=LL+LT
15    A(L)=A(L)+PIVI*A(LL)
      LLST=LLST+II
      LR=LLST+LT
      TB=ABS(A(LR))
      IF(TB-PIV)17,17,16
16    PIV=TB
      I=LR
      J=II+1
17    DO 18 LR=K,NM,M
      LL=LR+LT
18    R(LL)=R(LL)+PIVI*R(LR)
19    IF(LEND)24,23,20
20    II=M
      DO 22 I=2,M
      LST=LST-II
      II=II-1
      L=A(LST)+.5
      DO 22 J=II,NM,M
      TB=R(J)
      LL=J
      K=LST
      DO 21 LT=II,LEND
      LL=LL+1
      K=K+LT
21    TB=TB-A(K)*R(LL)
      K=J+L
      R(J)=R(K)
22    R(K)=TB
23    RETURN
24    IER=-1
      RETURN
      END
      FUNCTION ISW(I)
C     THIS IS A PSEUDO SENSE SWITCH ROUTINE
      DIMENSION JSW(20)
      IF(I.LT.0) GOTO1
      ISW=JSW(I)
      GOTO2
1     READ(60,3) JSW
 3     FORMAT (20I1)
      WRITE(61,4) JSW
4     FORMAT(5H ISW=,2(1X,10I1))
2     RETURN
       END
```

APPENDIX B

Data input to program TAL15,and output produced by the computer.

B 1

PROFILE SOUTH OF DIGBY TO PT. LAPREAU
ISW- 1011010010 1011000000
RDENS= 2.67,RWGT= 1335.0,RHOD= 0.25,REFX= 0.0 ,FXL= 0.0 ,DELAX= 5.000

LNO = 1 RHO = 2.670 WATER LAYER

8.000	0.0	00
100.000	0.0	00
96.000	0.020	00
90.000	0.040	00
76.000	0.060	00
65.000	0.120	00
61.000	0.140	00
55.000	0.140	00
46.000	0.120	00
47.000	0.120	00
39.000	0.130	00
30.000	0.120	00
25.000	0.100	00
20.000	0.060	00
15.000	-0.100	00
13.000	0.0	00
12.000	0.020	00
9.000	0.020	00
8.000	0.0	90

LNO = 2 RHO = 2.300 SCOTTS BAY FORMATION

25.000	0.100	00
30.000	0.120	00
38.000	0.130	00
47.000	0.120	00
48.000	0.120	00
55.000	0.140	00
61.000	0.140	00
65.000	0.120	00
65.000	1.000	00
45.000	0.700	00
27.000	0.300	00
25.000	0.100	90

8236166

LNO = 3 RHO = 2.640 NORTH MTN BSLT

25.000	0.100	00
27.000	0.300	00
45.000	0.700	00
65.000	1.000	00
65.000	1.300	00
45.000	0.900	00
27.000	0.500	00
13.000	0.0	00
15.000	-0.100	00
20.000	0.060	00
25.000	0.100	90

LNO = 4 RHO = 2.300 BLOMIDON FORMATION

8.000	0.0	00
9.000	0.020	00
12.000	0.020	00
13.000	0.0	00
27.000	0.500	00
45.000	0.900	00
65.000	1.300	00
63.000	1.600	00
47.000	1.000	00
44.000	1.000	00
13.000	0.450	00
12.000	0.400	00
8.000	0.0	90

```
LNO =    5      RHO =       2.850  GOLDENVILLE FMN
        -0.0         -0.150    00
         5.000       -0.100    00
         8.000        0.0      00
        13.000        0.450    00
        12.000        0.400    00
         9.000        0.800    00
         5.000        1.250    00
         0.0          0.100    00
       -10.000        0.200    00
       -10.000       -0.100    00
         0.0         -0.150    90

LNO =    6      RHO =       2.430  CARB & TRIASSIC
        65.000        0.120    00
        78.000        0.060    00
        90.000        0.040    00
        96.000        0.020    00
       100.000        0.0      00
        92.000        1.000    00
        86.000        2.800    00
        82.000        3.000    00
        76.000        2.800    00
        63.000        1.600    00
        65.000        1.300    00
        65.000        0.120    90

LNO =   99      RHO =       2.750  BASEMENT
       -10.000        0.200    00
         0.0          0.100    00
         5.000        1.250    00
         9.000        0.800    01
        12.000        0.400    00
        13.000        0.450    00
        44.000        1.000    00
        47.000        1.000    00
        63.000        1.600    00
        76.000        2.800    00
        82.000        3.000    01
        86.000        2.800    10
        92.000        1.000    00
       100.000        0.0      00
       120.000        0.0      00
       120.000        5.000    00
       -10.000        5.000    00
       -10.000        0.200    90
```

IMOD= 0,RMS ER= 0.9012,NPOINTS= 20,FILTERED RMS ER= 0.90120

K	FX(K)	FZ(K)	ANOMALY	CAL REF	RESIDUAL	OBS ANOMALY	WEIGHT	WGT DIFF	WEIGHTEST	FIL
1	0.0	0.0	14.69	11.00	0.0	11.00	1419.	84.	1335.	0.0
2	5.00	0.0	18.95	15.05	0.05	15.00	1416.	81.	1335.	0.1
3	10.00	0.0	14.19	10.30	0.30	10.00	1377.	42.	1340.	0.3
4	15.00	0.0	8.18	4.29	0.29	4.00	1409.	74.	1335.	0.3
5	20.00	0.0	8.96	5.06	1.06	4.00	1358.	23.	1335.	1.1
6	25.00	0.0	9.58	5.69	2.69	3.00	1360.	25.	1335.	2.7
7	30.00	0.0	6.66	2.77	-0.23	3.00	1352.	17.	1335.	-0.2
8	35.00	0.0	5.11	1.22	-0.78	2.00	1349.	14.	1335.	-0.8
9	40.00	0.0	3.47	-0.42	-1.42	1.00	1345.	10.	1335.	-1.4
10	45.00	0.0	1.98	-1.91	-0.91	-1.00	1341.	6.	1335.	-0.9
11	50.00	0.0	0.12	-3.77	1.23	-5.00	1337.	2.	1335.	1.2
12	55.00	0.0	-2.69	-6.58	0.42	-7.00	1330.	-5.	1335.	0.4
13	60.00	0.0	-5.80	-9.69	-0.69	-9.00	1323.	-12.	1335.	-0.7
14	65.00	0.0	-8.21	-12.10	-0.10	-12.00	1318.	-17.	1335.	-0.1
15	70.00	0.0	-11.93	-15.83	0.17	-16.00	1305.	-30.	1335.	0.2
16	75.00	0.0	-16.38	-20.27	-0.27	-20.00	1290.	-45.	1335.	-0.3
17	80.00	0.0	-18.39	-22.28	-0.28	-22.00	1282.	-53.	1335.	-0.3
18	85.00	0.0	-16.29	-20.18	-0.18	-20.00	1285.	-50.	1335.	-0.2
19	90.00	0.0	-6.04	-9.93	-0.93	-9.00	1325.	-10.	1335.	-0.9
20	95.00	0.0	5.85	1.96	0.96	1.00	1356.	21.	1335.	1.0

```
LNO=  99
  -22.28    -19.17    -16.06    -12.95     -9.84     -6.73     -3.61     -0.50      2.61      5.72      8.83     11.94     15.05
    I---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+---------I
  1 I                                                                       2                                 3             I
  2 I                                                                       2                                              3I
  3 I                                                                       .2                              31              I
  4 I                                                                       .2          31                                  I
  5 I                                                                       . 2        3   1                                I
  6 I                                                                       .       23       1                              I
  7 I                                                                      2.       3                                       I
  8 I                                                                   2   .  1 3                                          I
  9 I                                                                 2  1  . 3                                             I
 10 I                                                               1   32  .                                               I
 11 I                                                      3  1             .  2                                            I
 12 I                                                49                     .2                                              I
 13 I                                       1  3                        2   .                                               I
 14 I                                28                                    2.                                               I
 15 I                   31                                                 2.                                               I
 16 I     13                                                               2.                                               I
 17 13                                                                     2.                                               I
 18 I      3                                                               2.                                               I
 19 I                                       1  3                        2   .                                               I
 20 I                                                                       . 3  1                                          I
    I---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+---------I
```

B 3

8236168

PROFILE PORT GEORGE TO MARTIN HEAD
ISW- 1011010010 1011000000
RDENS= 2.67,RWGT= 1335.0,RHOO= 0.35,REFX= 0.0 ,FXI= 0.0 ,DEL=X= 5.000,H= 12,NFER= 0,IMAX

B 4

LNO = 1 RHO = 2.570 WATER LAYER

-2.000	0.0	00
54.000	0.0	00
51.000	0.020	00
46.000	0.040	00
23.000	0.035	00
26.000	0.039	00
23.000	0.045	00
15.000	0.045	00
15.000	0.050	00
10.000	0.060	00
3.000	0.040	00
0.0	0.020	00
-2.000	0.0	90

LNO = 2 RHO = 2.310 SCOT'S BAY FMN

3.000	0.040	00
10.000	0.060	00
15.000	0.060	00
15.000	0.045	00
23.000	0.045	00
25.000	0.039	00
23.000	0.200	00
23.000	0.500	00
19.000	1.000	00
3.000	0.040	90

LNO = 3 RHO = 2.640 NORTH MTN BSLT

-6.000	-0.080	00
-3.000	-0.180	00
-2.000	0.0	00
0.0	0.020	00
3.000	0.040	00
19.000	1.000	00
23.000	0.500	00
23.000	0.800	00
19.000	1.300	00
-6.000	-0.080	90

LNO = 4 RHO = 2.300 BLOMIDON FMN

-6.000	-0.080	00
19.000	1.300	00
23.000	0.800	00
23.000	0.500	00
28.000	0.100	00
28.000	1.000	00
19.000	1.500	00
-17.000	-0.080	00
-5.000	-0.080	90

LNO = 5 RHO = 2.300 TRIASSIC

28.000	0.035	00
45.000	0.040	00
51.000	0.020	00
43.000	0.700	00
28.000	0.300	00
28.000	0.035	90

LNO = 6 RHO = 2.700 PRE-CAMBRIAN

54.000	0.0	00
65.000	0.0	00
65.000	5.000	00
49.000	5.000	00
50.000	2.500	00
54.000	0.0	90

LNO = 7 RHO = 2.640 NORTH MTN BASALT

23.000	0.500	00
23.000	0.200	00
26.000	0.039	00
28.000	0.035	00
28.000	0.100	00
23.000	0.500	90

```
LNO =   8      RHO =      2.430   CARBONIFEROUS
        51.000      0.020   00
        54.000      0.0     00
        50.000      2.000   00
        43.000      1.700   00
        38.000      1.800   00
        29.000      0.800   00
        28.000      0.300   00
        43.000      0.700   00
        51.000      0.020   90

LNO =  99      RHO =      2.750   UNKNOWN BASEMENT
       -17.000     -0.080   00
        19.000      1.500   00
        28.000      1.000   01
        29.000      0.800   00
        39.000      1.800   00
        43.000      1.700   00
        50.000      2.000   01
        49.000      5.000   01
       -17.000      5.000   00
       -17.000     -0.080   90
```

IMOD= 0.RMS ER= 0.3403.NPOINTS= 12.FILTERED RMS ER= 0.84027

K	FX(K)	FZ(K)	ANOMALY	CAL REF	RESIDUAL	OBS ANOMALY	WEIGHT	WGT DIFF	WEIGHTEST	FIL.
1	0.0	0.0	5.71	4.00	0.0	4.00	1354.	19.	1335.	0.0
2	5.00	0.0	5.06	2.35	0.35	2.00	1349.	14.	1335.	0.4
3	10.00	0.0	1.16	-1.55	0.45	-2.00	1340.	5.	1335.	0.5
4	15.00	0.0	-2.73	-5.44	-0.44	-5.00	1329.	-6.	1335.	-0.4
5	20.00	0.0	-4.79	-7.50	-0.50	-7.00	1323.	-12.	1335.	-0.5
6	25.00	0.0	-1.42	-4.13	0.67	-5.00	1332.	-3.	1335.	0.9
7	30.00	0.0	-0.34	-3.05	-0.05	-3.00	1340.	5.	1335.	-0.1
8	35.00	0.0	-5.92	-8.63	-0.63	-8.00	1322.	-13.	1335.	-0.6
9	40.00	0.0	-9.46	-12.18	-0.18	-12.00	1312.	-23.	1335.	-0.2
10	45.00	0.0	-10.19	-12.90	0.10	-13.00	1312.	-23.	1335.	0.1
11	50.00	0.0	-9.43	-12.14	-1.14	-11.00	1161.	-174.	1201.	-1.1
12	55.00	0.0	4.99	2.28	2.28	0.0	1350.	15.	1335.	2.3

```
LNO=  99
 -13.00    -11.58    -10.17     -8.75     -7.33     -5.92     -4.50     -3.08     -1.67     -0.25      1.17      2.58      4.00
    I---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+I
  1 I                                                                                           2                          31I
  2 I                                                                                           . 2           3 1            I
  3 I                                                                             3  1          .  2                         I
  4 I                                                    1  3                                2  .                            I
  5 I                                      1  3                                             2   .                            I
  6 I                                                       3      1                            .     2                      I
  7 I                                                                     13                   2.                            I
  8 I                              1   3                                                   2    .                            I
  9 I     13                                                                                   2.                            I
 10 31                                                                                          2                            I
 11 I     1       3                                                                     2       .                            I
 12 I                                                                                           3               2            I
    I---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+I
1=THEO.2=RESIDUAL.3=OBSERVED.4=ELEVATION
```

PROFILE FROM DRAKE ET AL (1954) GRAVITY SIMULATION
ISW- 1011010010 1011000000
RDENS= 2.67,RWGT= 2670.0,RHOD= 0.25,REFX=300.00,FXI=200.00,DELFX=10.000

LNO = 1 RHO = 2.670 WATER LAYER

-20.000	0.0	00
394.000	0.0	00
380.000	0.060	00
374.000	0.060	00
362.000	0.060	00
345.000	0.100	00
334.000	0.160	00
308.000	0.200	00
297.000	0.150	00
269.000	0.240	00
267.000	0.180	00
253.000	0.240	00
237.000	0.240	00
148.000	0.210	00
133.000	0.030	00
128.000	0.150	00
119.000	0.150	00
102.000	0.090	00
97.000	0.210	00
78.000	0.240	00
3.000	0.060	00
-20.000	0.0	90

LNO = 2 RHO = 1.900 UNCONSOLIDATED YARMO

308.000	0.200	00
334.000	0.160	00
331.000	0.340	00
308.000	0.200	90

LNO = 4 RHO = 2.300 CONS CASHES LEDGE

133.000	0.030	00
148.000	0.210	00
237.000	0.240	00
253.000	0.240	00
250.000	0.450	00
240.000	0.500	00
210.000	1.100	00
190.000	1.200	00
148.000	0.670	00
133.000	0.030	90

LNO = 9 RHO = 2.740 SUB-BSMT

-20.000	0.0	00
5.000	0.240	00
78.000	0.430	00
99.000	0.300	00
105.000	4.000	01
160.000	4.000	01
133.000	0.030	00
148.000	0.670	00
190.000	1.200	00
210.000	1.100	00
240.000	0.500	00
250.000	0.450	00
253.000	0.240	00
267.000	0.180	00
269.000	0.240	00
269.000	5.000	00
-20.000	5.000	00
-20.000	0.0	90

B 8

```
LNO =    5     RHO =      2.700  BSMT YARMOUTH
      320.000        0.300   00
      325.000        0.400   00
      331.000        0.900   00
      337.000        0.500   00
      331.000        3.000   00
      325.000        1.000   00
      320.000        0.300   90

LNO =    7     RHO =      2.400   SED TROUGH
      269.000        0.240   00
      297.000        0.150   00
      288.000        0.700   00
      280.000        1.300   00
      275.000        1.500   00
      269.000        1.000   00
      269.000        0.240   90

LNO =    8     RHO =      2.300   TRIAS YAR TR
      308.000        0.200   00
      331.000        0.340   00
      334.000        0.160   00
      345.000        0.100   00
      337.000        0.500   00
      331.000        0.900   00
      325.000        0.400   00
      320.000        0.300   00
      308.000        0.200   90

LNO =   10     RHO =      2.650  GRANITE YARMOUTH
      394.000        0.0     00
      394.000        9.000   00
      340.000        9.000   00
      340.000        8.000   00
      360.000        5.000   00
      380.000        4.200   00
      380.000        0.060   00
      394.000        0.0     90

LNO =   11     RHO =      2.700   YARMOUYH HR EXTD
      362.000        0.060   00
      374.000        0.060   00
      370.000        1.000   00
      365.000        1.000   00
      362.000        0.060   90

LNO =   99     RHO =      2.300  BSMT-GOLDENVL
      297.000        0.150   00
      308.000        0.200   00
      320.000        0.300   00
      325.000        1.000   00
      331.000        3.000   01
      337.000        0.500   00
      345.000        0.100   00
      362.000        0.060   00
      365.000        1.000   00
      370.000        1.000   00
      374.000        0.060   00
      380.000        0.060   00
      380.000        4.200   00
      360.000        5.000   00
      340.000        8.000   00
      340.000        9.000   00
      394.000        9.000   00
      394.000       10.000   00
      350.000       10.000   00
      269.000       10.000   00
      -20.000       10.000   00
      -20.000        5.000   00
      269.000        5.000   00
      269.000        1.000   00
      275.000        1.500   01
      280.000        1.300   00
      288.000        0.700   00
      297.000        0.150   90
```

LNO=   0.RMS ER=   0.5944.NPOINTS=   18.FILTERED RMS ER=   0.59436

K	FX(K)	FZ(K)	ANOMALY	CAL REF	RESIDUAL	OBS ANOMALY	WEIGHT	WGT DIFF	WEIGHTEST	FIL
1	200.00	0.0	23.59	19.51	0.51	19.00	2728.	58.	2670.	0.5
2	210.00	0.0	24.79	20.70	0.70	20.00	2730.	60.	2670.	0.7
3	220.00	0.0	28.14	24.06	0.06	24.00	2739.	69.	2670.	0.1
4	230.00	0.0	31.78	27.70	-0.30	28.00	2748.	78.	2670.	-0.3
5	240.00	0.0	35.35	31.27	0.27	31.00	2757.	87.	2670.	0.3
6	250.00	0.0	36.91	32.83	0.83	32.00	2759.	89.	2670.	0.8
7	260.00	0.0	40.71	36.62	0.62	36.00	2769.	99.	2670.	0.6
8	270.00	0.0	35.29	31.20	0.20	31.00	2763.	93.	2670.	0.2
9	280.00	0.0	34.00	29.92	-0.08	30.00	2754.	84.	2670.	-0.1
10	290.00	0.0	44.28	40.20	0.20	40.00	2782.	112.	2670.	0.2
11	300.00	0.0	51.08	47.00	0.0	47.00	2798.	128.	2670.	0.0
12	310.00	0.0	49.92	45.84	0.84	45.00	2796.	126.	2670.	0.8
13	320.00	0.0	45.27	41.19	0.19	41.00	2787.	117.	2670.	0.2
14	330.00	0.0	28.06	23.97	-0.03	24.00	2738.	68.	2670.	-0.0
15	340.00	0.0	40.04	35.96	0.96	35.00	2780.	110.	2670.	1.0
16	350.00	0.0	38.35	34.27	-0.73	35.00	2761.	91.	2670.	-0.7
17	360.00	0.0	31.47	27.39	1.39	26.00	2739.	69.	2670.	1.4
18	370.00	0.0	23.47	19.39	0.39	19.00	2724.	54.	2670.	0.4

```
LNO=  99
    -0.73     3.24      7.22     11.20     15.18     19.15     23.13     27.11     31.09     35.07     39.04     43.02     47.00
   I---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+I
 1 I .2                                              31                                                                    I
 2 I . 2                                                3 1                                                                I
 3 I 2                                                           3                                                         I
 4 I2.                                                                    13                                               I
 5 I .2                                                                            3                                       I
 6 I . 2                                                                             3 1                                   I
 7 I .2                                                                                        3 1                         I
 8 I 2                                                                             3                                       I
 9 I 2                                                                          3                                          I
10 I 2                                                                                                   31                I
11 I 2                                                                                                                    3I
12 I . 2                                                                                                            3 1    I
13 I 2                                                                                                     3               I
14 I 2                                                          3                                                         I
15 I . 2                                                                                     3 1                           I
16 2 .                                                                                      1 3                            I
17 I .   2                                                    3   1                                                       I
18 I .2                                              31                                                                    I
   I---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+I
1=THEO.2=RESIDUAL.3=OBSERVED.4=ELEVATION
```

```
PROFILE SW OF N.S.        INCLUDES CAPE SABLE PROFILE
ISW- 1011010010 1011000000
RDENS= 2.67.RWGT=     1734.0.RHUD= 0.20.REFX= 30.00.FXI=  0.0 .DELFX= 5.000.M=  20.NFER=   0.

LNO =   1      RHO =      2.670  WATER LAYER
   -1000.000       0.0      00
    1000.000       0.0      00
    1000.000       0.100    00
     150.000       0.100    00
     133.000       0.180    00
     118.000       0.100    00
     102.000       0.090    00
      94.000       0.080    00
      90.000       0.080    00
      64.000       0.060    00
      54.000       0.080    00
      45.000       0.090    00
      35.000       0.100    00
      30.000       0.100    00
      12.000       0.100    00
      10.000       0.140    00
       5.000       0.100    00
       0.0         0.145    00
   -1000.000       0.145    00
   -1000.000       0.0      90
LNO =   2      RHO =      2.700  HALIFAX
      54.000       0.080    00
      64.000       0.060    00
      90.000       0.080    00
      94.000       0.030    00
      95.000       1.200    00
      87.000       1.300    00
      47.000       1.000    00
      39.000       1.600    00
      55.000       0.100    00
      45.000       0.090    00
      34.000       0.080    90

LNO =   3      RHO =      2.650  HALIFAX ETC
      15.000       1.000    00
      20.000       0.850    00
      30.000       0.100    00
      26.000       2.200    00
      19.000       2.100    00
      15.000       1.000    90

LNO =   5      RHO =      2.300  TRIASSIC
   -1000.000       0.145    00
       0.0         0.145    00
       5.000       0.100    00
      10.000       0.140    00
      12.000       0.100    00
      30.000       0.100    00
      20.000       0.850    00
      15.000       1.000    00
       6.000       1.350    00
       0.0         1.650    00
     -15.000       1.500    00
     -35.000       1.900    00
   -1000.000       1.900    00
   -1000.000       0.145    90

LNO =   6      RHO =      2.770  GOD ONLY KNOWS
     102.000       0.090    00
     118.000       0.100    00
     133.000       0.180    00
     150.000       0.100    00
    1000.000       0.100    00
    1000.000      12.000    00
     130.000      12.000    00
     130.000      10.000    00
     106.000       3.500    00
     102.000       0.090    90
```

LNO = 4 RHO = 2.800 GOLDENVILLE

-1000.000	1.900	00
-35.000	1.900	00
-15.000	1.500	00
0.0	1.650	00
6.000	1.350	00
15.000	1.000	00
19.000	2.100	00
26.000	2.200	00
28.000	0.100	00
35.000	0.100	00
39.000	1.600	00
47.000	1.000	00
87.000	1.300	00
80.000	2.000	00
68.000	6.300	00
60.000	9.000	00
50.000	7.500	00
45.000	9.000	00
40.000	12.000	00
-1000.000	12.000	00
-1000.000	1.900	90

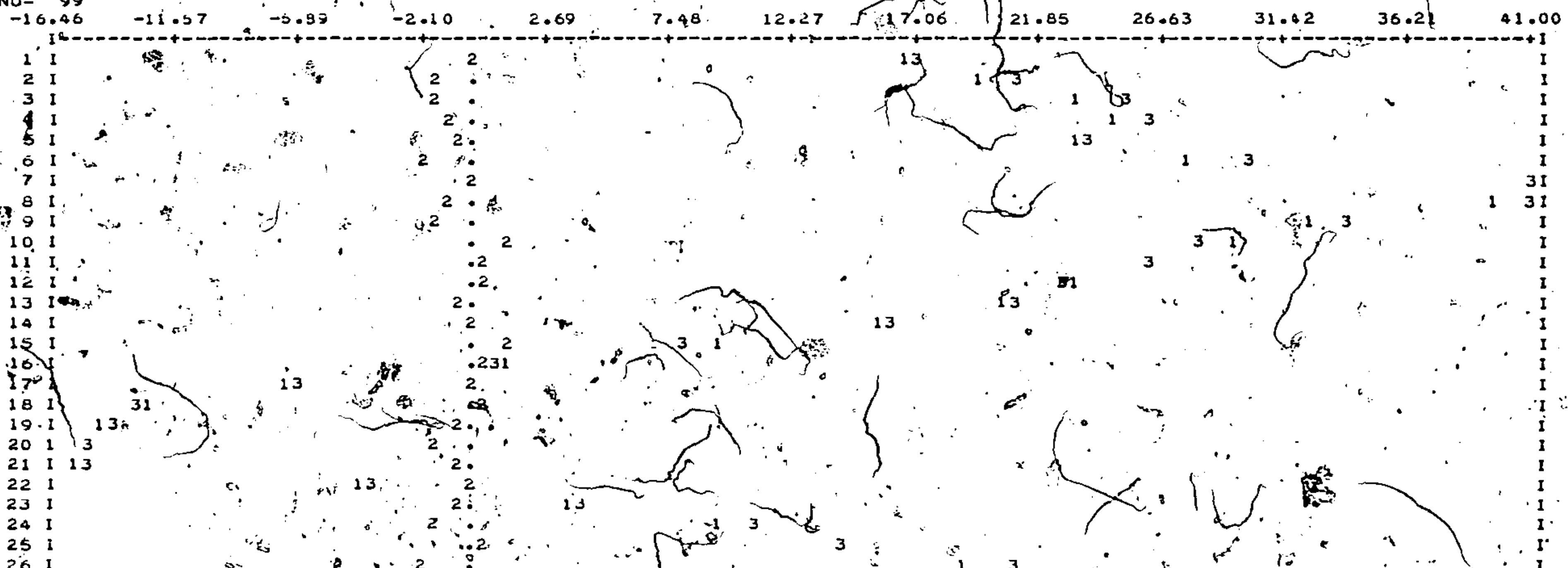
LNO = 99 RHO = 2.650 GRANLTE-

56.000	12.000	00
40.000	12.000	00
45.000	9.000	00
50.000	7.500	00
60.000	9.000	00
68.000	6.300	00
80.000	2.000	00
87.000	1.300	00
95.000	1.200	00
94.000	0.080	00
102.000	0.090	00
106.000	3.500	00
130.000	10.000	00
130.000	12,000	00
56.000	12.000	90

IMOD= 0.RMS ER= 1.0876.NPOINTS= 26.FILTERED RMS ER= 1.08736

K	FX(K)	FZ(K)	ANOMALY	CAL REF	RESIDUAL	OBS ANOMALY	WEIGHT	WGT DIFF	WEIGHTEST	FIL
1	0.0	0.0	32.75	16.71	-0.29	17.00	3283.	1549.	3204.	-0.3
2	5.00	0.0	35.41	19.36	-1.64	21.00	3294.	1560.	3204.	-1.6
3	10.00	0.0	39.40	23.36	-1.64	25.00	3305.	1571.	3204.	-1.6
4	15.00	0.0	41.00	24.95	-1.05	25.00	3314.	1580.	3204.	-1.0
5	20.00	0.0	39.30	23.26	-0.74	24.00	3302.	1568.	3204.	-0.7
6	25.00	0.0	43.85	27.80	-2.20	30.00	3314.	1580.	3204.	-2.2
7	30.00	0.0	57.05	41.00	0.0	41.00	3359.	1625.	3204.	0.0
8	35.00	0.0	55.69	39.65	-1.35	41.00	3359.	1625.	3204.	-1.4
9	40.00	0.0	48.65	32.61	-1.39	34.00	3344.	1610.	3204.	-1.4
10	45.00	0.0	45.46	29.43	1.43	28.00	3303.	1569.	3204.	1.4
11	50.00	0.0	42.15	26.11	0.11	26.00	3282.	1548.	3204.	0.1
12	55.00	0.0	39.30	23.25	0.25	23.00	3293.	1559.	3204.	0.3
13	60.00	0.0	36.31	20.26	-0.74	21.00	3304.	1570.	3204.	-0.7
14	65.00	0.0	31.69	15.96	-0.35	16.00	3278.	1544.	3204.	-0.4
15	70.00	0.0	25.20	9.16	1.16	8.00	3252.	1518.	3204.	1.2
16	75.00	0.0	17.27	1.22	0.22	1.00	3225.	1491.	3204.	0.2
17	80.00	0.0	8.80	-7.24	-0.24	-7.00	3197.	1463.	3204.	-0.2
18	85.00	0.0	3.46	-12.59	0.41	-13.00	3189.	1455.	3204.	0.4
19	90.00	0.0	1.27	-14.78	-0.78	-14.00	3186.	1452.	3204.	-0.8
20	95.00	0.0	-0.42	-16.46	-1.46	-15.00	3180.	1446.	3204.	-1.5
21	100.00	0.0	0.53	-15.52	-0.52	-15.00	3180.	1446.	3204.	-0.5
22	105.00	0.0	11.74	-4.30	-0.30	-4.00	3211.	1477.	3204.	-0.3
23	110.00	0.0	19.47	3.42	-0.58	4.00	3234.	1500.	3204.	-0.6
24	115.00	0.0	25.20	9.16	-1.84	11.00	3250.	1516.	3204.	-1.8
25	120.00	0.0	30.40	14.35	0.35	14.00	3266.	1532.	3204.	0.4
26	125.00	0.0	35.13	19.08	-1.92	21.00	3282.	1548.	3204.	-1.9

LNO= 99

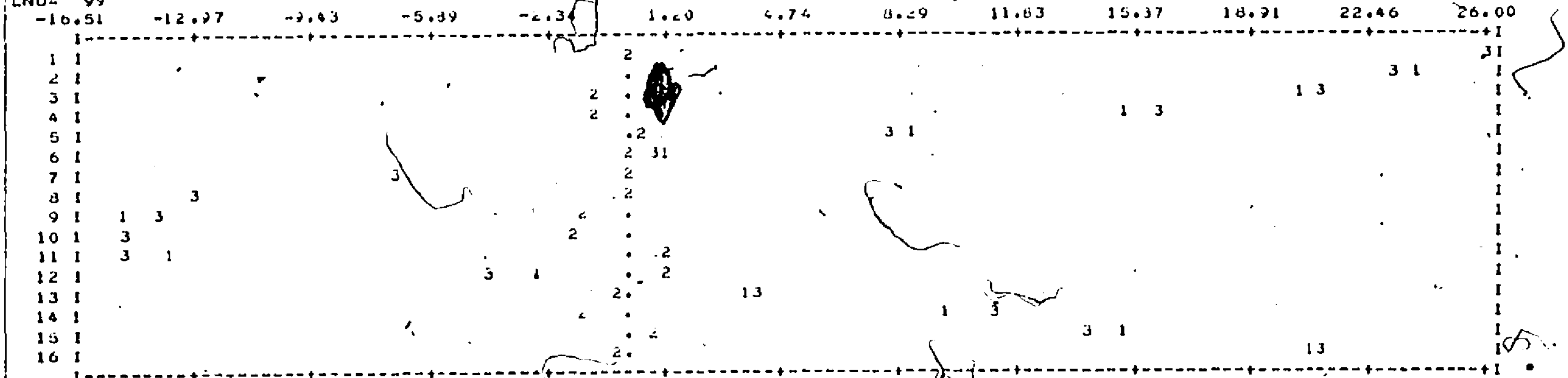


```
DATA TEST    NORMAL CASE
ISW- 1011010010 1011000000
RDENS= 2.67,RWGT=     1734.0,RHOO=-0.15,RBFX=  0.0 ,FXI=  0.0 ,DELFX= 5.000,M=  1[illegible],NFER=   0.1

LNO =              RHO =      2.670  WATER LAYER
   -1000.000        0.0      00
       0.0          0.0      00
     100.000        0.0      00
    1000.000        0.0      00
    [illegible]000.000        0.100    00
    [illegible]00.000         0.100    00
      8[illegible].000          0.180    00
      6[illegible].000          0.100    00
      40.000          0.080    00
      14.000          0.060    00
       0.0            0.090    00
   -1000.000        0.090    00
     [illegible]             0.0      90
LNO =              RHO =      2.750      SEDIMENT
   -1000.000        0.090    00
       0.0          0.090    00
      [illegible].000          0.060    00
      40.000          0.080    00
      63.000          0.100    00
      [illegible]1.000          0.130    00
     [illegible]00.000          0.100    00
    [illegible]00.000          0.100    00
   [illegible]000.000          9.000    00
      7[illegible].000          9.000    00
      [illegible]7.000          5.000    01
      65.000          5.300    00
      5[illegible].000          2.700    00
      52.000          2.000    00
      51.000          1.200    00
      50.000          0.300    00
      45.000          0.400    00
      44.000          0.500    00
      35.000          0.900    00
      30.000          1.700    00
      18.000          5.500    00
       5.000          9.000    00
   -1000.000        9.000    00
   -1000.000        0.090    90

LNO = 99           RHO =      [illegible].500  DEVONIAN GRANITE
       5.000          9.000    00
      18.000          5.500    00
      30.000          1.700    00
      35.000          0.900    00
      44.000          0.500    00
      45.000          0.400    00
      50.000          0.300    00
      51.000          1.200    00
      52.000          2.000    01
      55.000          2.700    01
      65.000          5.300    00
      71.000          5.000    00
      73.000          9.000    00
       5.000          9.000    90
```

IMOD= 0,RMS ER= 0.5929,NPOINTS= 16,FILTERED RMS ER= 0.69292

K	FX(K)	FZ(K)	ANOMALY	CAL REF	RESIDUAL	OBS ANOMALY	WEIGHT	WGT DIFF	WEIGHTEST	FIL
1	0.0	0.0	25.68	26.00	0.0	25.00	2474.	740.	2403.	0.0
2	5.00	0.0	23.55	23.87	0.87	23.00	2474.	740.	2403.	0.9
3	10.00	0.0	19.93	20.25	-0.75	[illegible]	2457.	723.	2403.	-0.8
4	15.00	0.0	14.77	15.09	-0.91	16.00	2435.	701.	2403.	-0.9
5	20.00	0.0	8.31	8.63	0.63	5.00	2412.	676.	2403.	0.6
6	25.00	0.0	0.82	1.14	0.14	1.00	2389.	655.	2403.	0.1
7	30.00	0.0	-7.23	-6.91	0.09	-7.00	2365.	631.	2403.	0.1
8	35.00	0.0	-13.18	-12.86	0.14	-13.00	2353.	619.	2403.	0.1
9	40.00	0.0	-15.57	-15.25	-1.25	-14.00	2350.	616.	2403.	-1.3
10	45.00	0.0	-16.83	-16.51	-1.61	-15.00	2345.	611.	2403.	-1.5
11	50.00	0.0	-13.95	-13.63	1.37	-15.00	2344.	610.	2403.	1.4
12	55.00	0.0	-3.16	-2.84	1.16	-4.00	2380.	646.	2403.	1.2
13	60.00	0.0	3.53	3.85	-0.15	4.00	2399.	665.	2403.	-0.2
14	65.00	0.0	9.24	9.56	-1.44	11.00	2419.	685.	2403.	-1.4
15	70.00	0.0	14.65	14.97	0.97	14.00	2415.	681.	2403.	1.0
16	75.00	0.0	20.44	20.76	-0.24	21.00	2474.	740.	2403.	-0.2

LNO= 99



1=THEO,2=RESIDUAL,3=OBSERVED,4=ELEVATION

B 14

TEST OF CAPE SABLE GRAVITY LOW   PROFILE A-AA   CASE 1 DATA
ISW- 101010010 1011000000
RDENS= 2.67,RWGT=   1734.0,RHOD=-0.15,REFX= 0.0 ,FXI= -0.0 ,DELFX= 5.000,M= 16,NFER=   0.1

LNO = 1   RHO = 2.670 -WATER LAYER

-1000.000	0.0	00
0.0	0.0	00
100.000	0.0	00
1000.000	0.10	00
1000.000	0.100	00
100.000	0.100	00
83.000	0.180	00
68.000	0.100	00
40.000	0.080	00
14.000	0.060	00
0.0	0.090	00
-1000.000	0.090	00
-1000.000	0.0	90

LNO = 4   RHO = 2.750   SEDIMENT

-1000.000	0.090	00
0.0	0.090	00
14.000	0.060	00
40.000	0.080	00
68.000	0.100	00
83.000	0.180	00
100.000	0.100	00
1000.000	0.100	00
1000.000	13.000	00
69.000	13.000	00
67.000	8.100	00
61.000	4.000	00
54.000	3.000	00
53.000	2.000	00
51.000	1.100	00
45.000	1.500	00
38.000	1.600	00
36.000	2.000	00
30.000	2.500	00
27.000	3.300	00
24.000	5.500	00
18.000	8.000	00
12.000	9.600	00
3.000	13.000	00
-1000.000	13.000	00
-1000.000	0.090	90

LNO = 99   RHO = 2.600   DEVONIAN GRANITE

3.000	13.000	00
12.000	9.600	00
18.000	8.000	01
24.000	5.500	00
27.000	3.300	00
30.000	2.500	00
36.000	2.000	00
38.000	1.600	00
45.000	1.500	01
51.000	1.100	00
53.000	2.000	00
54.000	3.000	00
61.000	4.000	01
67.000	8.100	00
69.000	13.000	00
3.000	13.000	90

B 16

IMOD= 0.RMS ER= 0.9867.NPOINTS= 16.FILTERED RMS ER= 0.98673

K	FX(K)	FZ(K)	ANOMALY	CAL REF	RESIDUAL	OBS ANOMALY	WEIGHT	WGT DIFF	WEIGHTEST	FIL
1	0.0	0.0	34.55	31.00	0.0	31.00	3574.	1840.	3471.	0.0
2	5.00	0.0	31.08	27.54	-0.46	28.00	3563.	1829.	3471.	-0.5
3	10.00	0.0	26.31	22.76	-0.24	23.00	3535.	1801.	3471.	-0.2
4	15.00	0.0	20.33	16.79	-0.21	17.00	3512.	1778.	3471.	-0.2
5	20.00	0.0	13.02	9.47	-1.53	11.00	3487.	1753.	3471.	-1.5
6	25.00	0.0	3.79	0.24	0.24	0.0	3451.	1717.	3471.	0.2
7	30.00	0.0	-5.84	-9.38	-0.38	-9.00	3417.	1683.	3471.	-0.4
8	35.00	0.0	-11.49	-15.04	0.[illegible]6	-16.00	3411.	1677.	3471.	1.0
9	40.00	0.0	-14.85	-18.39	0.61	-19.00	3403.	1669.	3471.	0.6
10	45.00	0.0	-15.40	-18.94	0.06	-19.00	3402.	1668.	3471.	0.1
11	50.00	0.0	-14.20	-17.74	0.26	-18.00	3397.	1663.	3471.	0.3
12	55.00	0.0	-4.65	-8.20	0.80	-9.00	3426.	1692.	3471.	0.8
13	60.00	0.0	4.61	1.06	0.06	1.00	3437.	1703.	3471.	0.1
14	65.00	0.0	15.62	12.08	1.08	11.00	3480.	1746.	3471.	1.1
15	70.00	0.0	25.09	21.55	1.55	20.00	3574.	1840.	3471.	1.5
16	75.00	0.0	31.22	27.67	2.67	25.00	3574.	1840.	3471.	2.7

```
LNO=  99
  -19.00    -14.83    -10.57     -6.50     -2.33      1.83      6.00     10.17     14.33     18.50     22.67     26.83     31.00
    I---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+I
  1 I                                             2                                                                         3I
  2 I                                           2 .                                                               13        I
  3 I                                            2.                                                    13                   I
  4 I                                            21                                      3                                  I
  5 I                                         2   .                    1   3                                                I
  6 I                                             3                                                                          I
  7 I                      13                    2.                                                                          I
  8 I      3  1                                   . 2                                                                        I
  9 31                                            .2                                                                         I
 10 3                                             2                                                                          I
 11 1 31                                          2                                                                          I
 12 I                       3 1                   . 2                                                                        I
 13 I                                             2 3                                                                        I
 14 I                                             . 2                      3  1                                              I
 15 I                                             .  2                                           3  1                        I
 16 I                                             .     2                                                    3     1         I
    I---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+I
1=THEO.2=RESIDUAL.3=OBSERVED.4=ELEVATION
```

```
DATA TEST     CASE 2 DATA
ISW- 1011010010 1011000,000
RDENS= 2.57,RWGT=     1734.0,RHOD=-0.15,REFX=  0.0 ,FXI=  0.0 ,DELFX= 5.000,M=  16,NFER=   0.

LNO =   1       RHO =      2.570  WATER LAYER
    -1000.000       0.0       00
       0.0          0.0       00
     100.000        0.0       00
    1000.000        0.0       00
    1000.000        0.100     00
     100.000        0.100     00
      80.000        0.180     00
      68.000        0.100     00
      40.000        0.030     00
      14.000        0.060     00
       0.0          0.090     00
   -1000.000        0.090     00
   -1000.000        0.0       90
LNO =   2       RHO =      2.750       SEDIMENT
   -1000.000        0.090     00
       0.0          0.090     00
      14.000        0.060     00
      40.000        0.080     00
      68.000        0.100     00
      81.000        0.100     00
     100.000        0.100     00
    1000.000        0.100     00
    1000.000        6.700     00
      75.000        6.700     00
      75.000        5.500     00
      67.000        4.000     00
      54.000        1.900     00
      51.000        0.600     00
      50.000        0.300     00
      45.000        0.400     00
      44.000        0.800     00
      41.000        1.000     00
      35.000        1.200     00
      27.000        3.000     00
      13.000        4.000     00
       5.000        6.700     00
   -1000.000        6.700     00
   -1000.000        0.090     90

LNO =   3       RHO =      2.600       DEVONIAN GRANITE
       5.000        6.700     00
      13.000        4.500     01
      13.000        4.000     00
      27.000        3.000     00
      35.000        1.200     00
      41.000        1.000     00
      44.000        0.800     01
      45.000        0.400     00
      50.000        0.300     00
      51.000        0.600     01
      54.000        1.900     00
      67.000        4.000     01
      75.000        5.500     01
      75.000        6.700     00
       6.000        6.700     90
```

IMOD= 0,RMS ER= 0.9595,NPOINTS= 16,FILTERED RMS ERR= 0.95978

K	FX(K)	FZ(K)	ANOMALY	CAL REF	RESIDUAL	OBS ANOMALY	WEIGHT	WGT DIFF	WEIGHTEST	FIL
1	0.0	0.0	19.32	21.00	0.0	21.00	1842.	108.	1789.	0.0
2	5.00	0.0	17.33	19.01	1.01	18.00	1842.	108.	1789.	1.0
3	10.00	0.0	13.34	15.03	1.03	14.00	1745.	11.	1713.	1.0
4	15.00	0.0	8.46	10.14	-0.86	11.00	1799.	65.	1789.	-0.9
5	20.00	0.0	4.94	6.62	-0.38	7.00	1794.	60.	1789.	-0.4
6	25.00	0.0	1.96	3.64	-0.36	4.00	1769.	55.	1789.	-0.4
7	30.00	0.0	-2.20	-0.52	1.48	-2.00	1776.	42.	1789.	1.5
8	35.00	0.0	-7.51	-5.63	1.37	-7.00	1759.	25.	1789.	1.2
9	40.00	0.0	-9.77	-8.06	0.92	-9.00	1757.	23.	1789.	0.9
10	45.00	0.0	-12.63	-10.95	-0.95	-10.00	1747.	13.	1789.	-1.0
11	50.00	0.0	-12.36	-10.68	-0.68	-10.00	1746.	12.	1789.	-0.7
12	55.00	0.0	-3.75	-2.07	0.93	-3.00	1772.	38.	1789.	0.9
13	60.00	0.0	1.26	2.94	-0.06	3.00	1784.	30.	1789.	-0.1
14	65.00	0.0	5.90	7.58	0.58	7.00	1796.	62.	1789.	0.6
15	70.00	0.0	10.58	12.26	1.26	11.00	1810.	76.	1789.	1.3
16	75.00	0.0	15.09	16.77	1.77	15.00	1832.	98.	1789.	1.8

```
LNO=  99
 -10.95    -8.29     -5.63     -2.96     -0.30      2.36       .02      7.69     10.35     13.01     15.67     18.34     21.00
    I---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+I
  1 I                                        2                                                                              3I
  2 I                                        .  2                                                               3   1        I
  3 I                                        .  2                                                3   1                       I
  4 I                                     2  .                                    1  3                                       I
  5 I                                       2.                        13                                                     I
  6 I                                       2.             13                                                                I
  7 I                                 3    1 .     2                                                                         I
  8 I              3   1                     .    2                                                                          I
  9 I      3   1                             .  2                                                                            I
 10 1   3                                 2  .                                                                               I
 11 I1  3                                  2 .                                                                               I
 12 I                             3  1       .  2                                                                            I
 13 I                                        2          3                                                                    I
 14 I                                        .                        3  1                                                   I
 15 I                                        .    2                                  3    1                                  I
 16 I                                        .      2                                               3      1                 I
    I---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+I
1=THEO,2=RESIDUAL,3=OBSERVED,4=ELEVATION
```