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Regional Gravity Survey of the Sverdrup Islands and Vicinity with map

No. 11—Sverdrup Islands

L. W. Sobczak

OTTAWA, CANADA

Department of Mines and Technical Surveys

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Roger Duhamel, F.R.S.C.
Queen's Printer and Controller of Stationery
Ottawa, Canada
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Available by mail from the Queen's Printer, Ottawa,
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Regional Gravity Survey of the Sverdrup Islands and Vicinity

L.W. Sobczak

Abstract: The results of gravity surveys carried out in 1959 and 1960 are presented in the form of an anomaly map from which five profiles are drawn to analyze the major features of the Bouguer anomaly field. The observations are correlated with magnetic and geological information and the interpretation of the gravity data is based on measured densities and densities computed from seismic velocities. On the basis of a density contrast of 0.14 gm/cc and an anomaly change of 63 mgals over a distance of 120 miles, the calculations indicate depths to basement varying from 6,800 feet near Isachsen to possibly 42,000 feet near the axis of the Sverdrup Basin. A broad positive Bouguer anomaly over Peary Channel is partly attributed to a corresponding broad lens of basic rocks extending from an outcrop on the Fay Islands. A sharp negative anomaly over Peary Channel north of the Dumbbell gypsum dome suggests a similar but larger submerged dome.

Résumé: Les résultats des levés gravimétriques effectués en 1959 et en 1960 sont présentés sous forme d'une carte d'anomalies dont on a tiré cinq profils pour analyser les principaux aspects du champ des anomalies de Bouguer. Les observations sont mises en corrélation avec les renseignements d'ordre magnétique et géologique et l'interprétation des données gravimétriques est fondée sur les densités mesurées et les densités calculées à partir des vitesses séismiques. En tenant compte d'un contraste de densité de 1.14 gm/cc et d'une variation anomale de 63 milligals sur une distance de 120 milles, les calculs indiquent une profondeur au fond variant de 6,800 pieds près d'Isachsen à peut-être 42,000 pieds près de l'axe du bassin Sverdrup. On attribue en partie une large anomalie positive au-dessus du canal Peary à une vaste lentille correspondante de roches basiques qui s'étend à partir d'un affleurement dans les îles Fay. Une anomalie négative prononcée au-dessus du canal Peary au nord du dôme de gypse Dumbbell laisse supposer l'existence d'un dôme submergé semblable mais plus important.

Figure 1. Index map for the gravity survey

INTRODUCTION

This paper gives in part the results of gravity surveys carried out by the Dominion Observatory in conjunction with the Polar Continental Shelf Project during the field seasons of 1960 and 1961. The survey area lies about 700 miles from the North Pole and covers the Sverdrup Islands inland from the Arctic Ocean (Figures 1 and 2). The main base of operations was the weather station at Isachsen on Ellef Ringnes Island. During the two field seasons 1,460 regional gravity stations were established at a grid interval of eight to ten miles over both land and sea-ice area. In addition, 370 detail gravity stations spaced at a much closer interval were observed over the Meighen Island Icecap, over the gypsum domes on Ellef Ringnes Island and over several interesting basic rock intrusions. The results of the surveys over the icecap and the gypsum domes are discussed in papers now in preparation at the Dominion Observatory. A network of control stations, discussed in a later paper, was established at easily relocatable sites 60 to 80 miles apart and all regional and detail stations were tied to this network. Values of gravity used in this report and on the map are based upon those adopted for the primary control station at Resolute, N.W.T. (Bancroft, 1958).

Other regional gravity work, in conjunction with the Polar Continental Shelf Project, was carried out over the sea ice north of the area outlined in Figure 1 and is the subject of another report (Weber, in press).

The purpose of this paper is to present the gravity results in the form of Bouguer and free-air anomaly maps and to discuss the structural and geological implications of the larger gravitational features. Estimates of the thicknesses of geological formations are made from the anomalies on the basis of densities calculated from seismic data and those obtained from surface sampling.

TRANSPORTATION

Transportation to and within the region was achieved mainly by rotary and fixed-wing aircraft. In 1960 both Bell 47-G and Otter aircraft were employed throughout the survey for the regional work, while a Bombardier snowmobile and motor toboggan were used for some of the detailed traverses. Initially the helicopters lacked adequate navigational instruments and as the weather was unpredictable, with frequent whiteouts and fog, the spring observations were restricted to coastlines of the islands where the position of the gravity stations could be readily established from maps. After the fifteenth of May when the decca navigation system commenced operation, systematic mapping of the area became possible. Temporary camps, spaced at intervals of 60 to 80 miles, served both as helicopter bases and control points for the gravity work. Gas caches were established at these bases by Otter aircraft and, as a safety precaution, at several intermediate points. The range of operation with the helicopter from each base was limited to 35 to 45 miles depending upon the number of stations observed on each traverse.

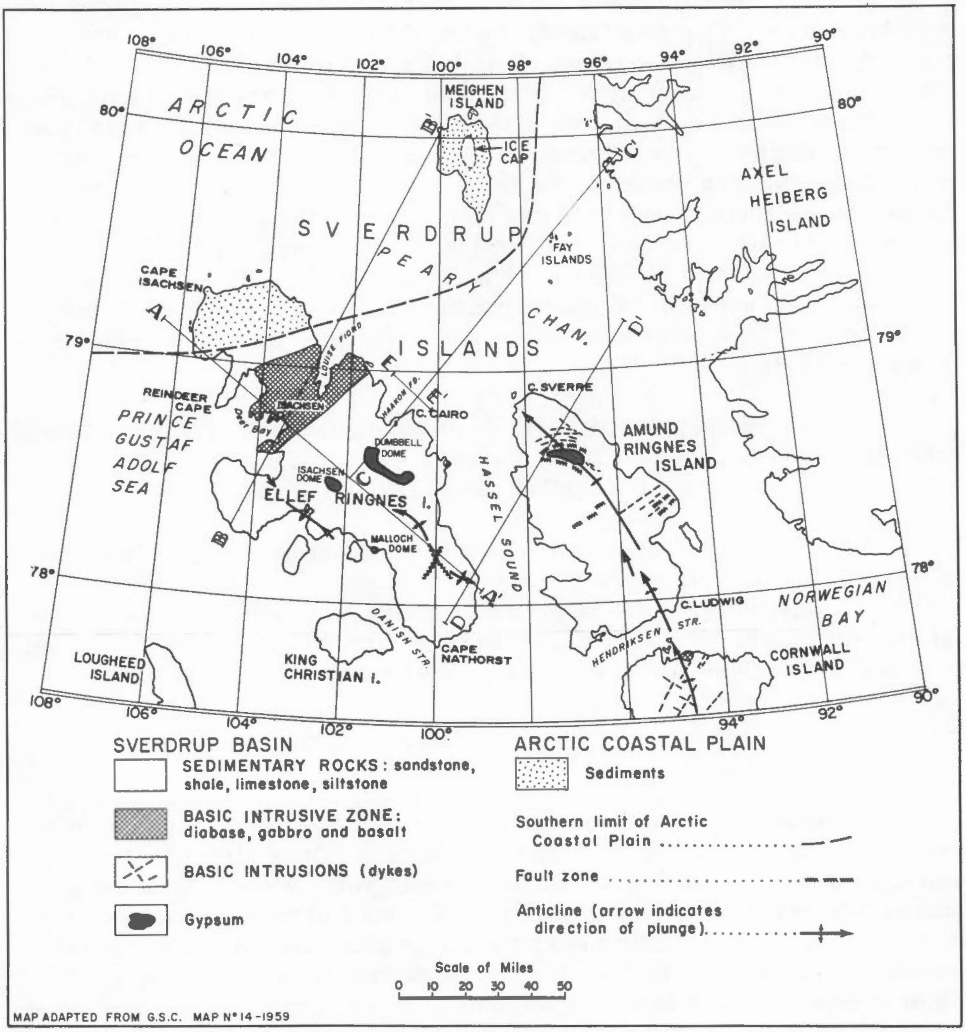

Figure 2. Geological sketch map for the area

In 1961 larger helicopters, a Bell 47G-2A and a Sikorsky S-55, were employed because of their longer range, better performance and greater load capacities. The former was used almost exclusively for measurements over the land areas where the range of operation was 45 to 55 miles. The S-55 was shared by the hydrographer and the gravity observer over the sea areas so that for each gravity station an accurate determination of water depth was available. As in 1960, a ski-wheel equipped Otter was employed to establish the gravity control network and set up the required camps and gas caches.

THE MEASUREMENTS

a) The Gravimeter Measurements

All gravity observations discussed here were made with two thermostatically controlled Worden gravimeters, Nos. 573 and 460, which had higher than usual damping characteristics to facilitate reading under the unstable conditions of sea ice. After considerable experimentation the optimum setting for the temperature control unit was found to be 65°F. This setting minimized battery drain but was not sufficiently low to alter seriously the calibration of the instrument (Damrel, 1960). The experiment was conducted over a gravity range provided by a 500-foot hill near Isachsen, where a series of readings at various operating temperatures was taken at the top and bottom of the hill with the Worden No. 573. During the course of these measurements the outside temperature was never higher than 32°F.

In 1960, 413 regional and 306 detail gravity stations were established. Of the detail stations, 236 were observed over the Meighen Island Icecap and over the gypsum domes of Ellef Ringnes Island. The remaining seventy detail stations were observed along a seismic refraction profile over Deer Bay near Isachsen. In 1961, 1,050 regional and 60 detail gravity stations were observed. The latter are located on Ellef Ringnes Island, thirty-two over the basic rocks between Deer Bay and Louise Fiord, and the remainder over the gypsum domes (Figure 2).

During both seasons the gravity observer attempted to occupy a control station at least once every three hours in order to remove the effect of drift or creep as completely as possible. In order to assess the accuracy of the gravity observations a few land and sea-ice stations were reoccupied. The analysis of these results yielded uncertainties of ± 0.04 mgal for the land stations and ± 0.12 mgal for the sea-ice stations.

b) Determination of Elevation and Sea Depth

Wallace and Tiernan altimeters were used to obtain the elevations for the land stations and an Edo echo sounder was employed for water depths. The traverses were planned in such a way that sea-level observations could be made at intervals of one hour or less to provide corrections for barometric pressure changes. Using this technique errors in elevation rarely exceeded 10 feet, which corresponds to an error of about 0.60 mgal in the gravity anomalies. The elevations of the stations for the detail traverses northwest of Isachsen were determined by spirit levelling and have negligible error.

The measurements of sea depths were carried out by M. Eaton of the Canadian Hydrographic Service who points out that two sources of error may be expected. First, the Edo sounder has a possible reading error of 5 feet regardless of the depths measured. Secondly, the velocity of the incident and reflected wave varies with temperature, salinity, and hydrostatic pressure of the sea water, so that for depths greater than 250 feet, the total error is estimated to be about two per cent of the depth. On this basis, the maximum error in depths for sea stations is about 50 feet in the Peary Channel region, which corresponds to an uncertainty of about 1 mgal in the Bouguer anomaly. Although sea depths were determined at the actual site of the gravity observations for most stations the depths for forty-six were obtained by interpolation.

c) Determination of Position

Except for coastal areas where visual navigation is possible horizontal control was provided by the decca navigation system consisting of a master transmitting and monitor receiving station at Cape Isachsen on Ellef Ringnes Island and two slave transmitting stations, one on Meighen Island and the other on Borden Island. The data obtained from the decca receivers installed in the helicopters and fixed-wing aircraft enabled the observer to obtain preliminary geographic station coordinates while in the field. Corrections for variations in conductivity over the transmission path and for aircraft characteristics are applied later and the final station coordinates obtained by use of an electronic computer.

The positions of the gravity stations over the Arctic Ocean are more accurate than over the land or over the ice between the islands because there are fewer variables affecting the decca transmission paths (Figure 3). As can be seen from Figure 2 the positional errors vary from 218 to 1,600 yards depending upon distance from the master station and the angles of intersections between transmission paths. Such errors lead to uncertainties of 0.06 to 0.50 mgal in the Bouguer anomalies. New phase-lag charts now in preparation will undoubtedly reduce these positional errors.

The errors in the gravity anomalies arising from the sources outlined are summarized in Table I. From this table it can be seen that the largest errors arise from the depth measurements coincident with depth determinations, thus eliminating the necessity of interpolations. The estimated maximum error in the Bouguer anomaly varies from ± 1.14 mgals for land stations to ± 2.24 mgals for sea-ice stations. As is shown later such errors are insignificant in comparison with the magnitudes of the gravity anomalies under discussion.

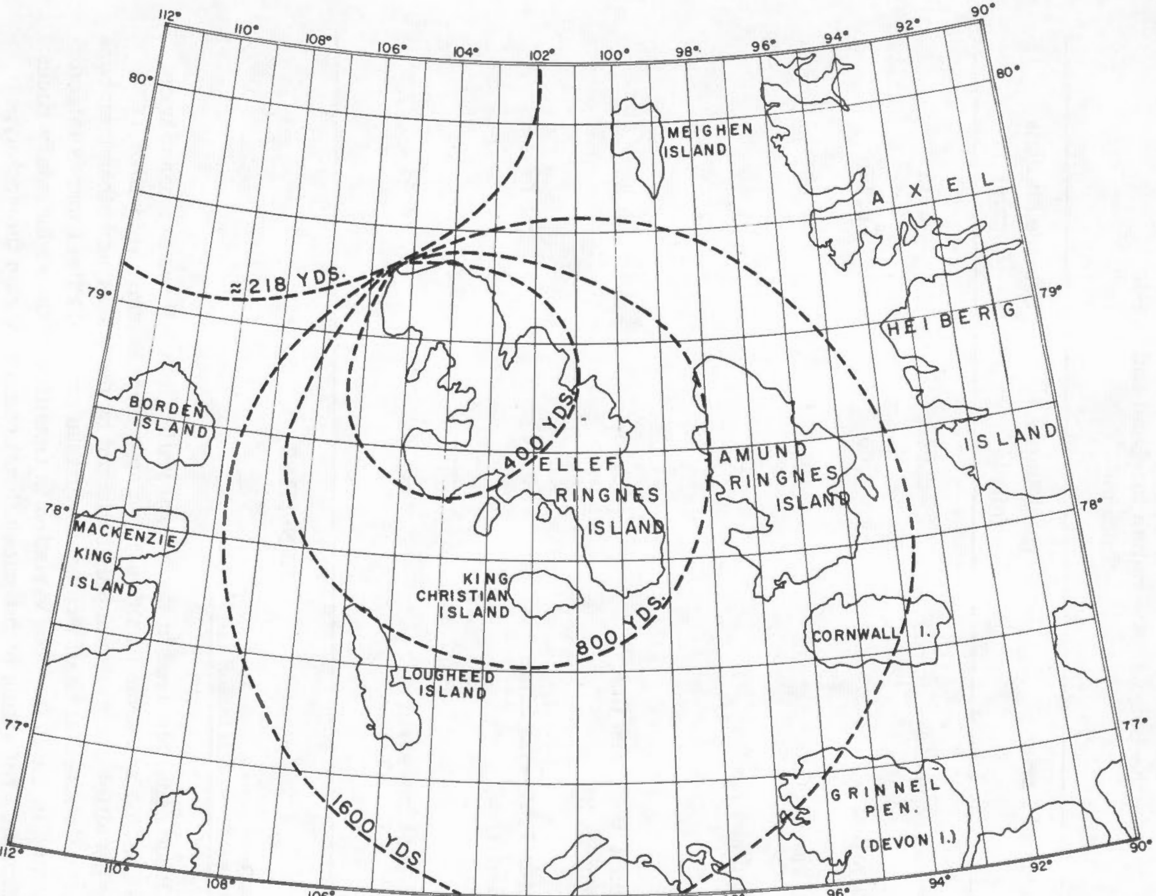

Figure 3. Contour map used to provide accuracy of station positions using decca navigation system

TABLE I

Estimated Maximum Error
in
the Bouguer Anomalies for Land and Sea-ice
Stations

Source of Error	Land Stations (mgals)	Sea-ice Stations (mgals)
Gravity measurements	±0.04	±0.12
Station elevation	±0.60	±0.16
Measured sea depths	-	±1.00
Interpolated sea depths	-	±1.50
Locations		
a) Within 1,600-yard line (Figure 2)	±0.25	±0.25
b) Outside 1,600-yard line (Figure 2)	±0.50	±0.50
Total possible error	±1.14	±2.24

DENSITIES

a) Densities from Surface Sampling

Rock densities used in the interpretation that follows are based upon surface sampling and upon densities calculated from seismic velocities. Mean dry densities for rock samples collected by the author and other members of the Polar Continental Shelf Project in various parts of Ellef Ringnes Island are presented in Table II. The variation in densities of the sedimentary rocks is considerable, reflecting both compositional changes within the rock types and inadequate sampling owing to overburden and snow cover. The average density of the sedimentary rocks of the Sverdrup Basin is 2.56 gms/cc obtained by weighting according to estimates of the relative abundance of each rock type.

On the other hand, the basic rocks that proved easier to sample were found to be more uniform in density with a mean of 2.94 gms/cc. Gypsum, the only other rock type considered separately in the interpretation, has a mean density of 2.36 gms/cc based upon three samples only.

TABLE II

Rock densities from surface sampling

1 Rock type	2 No. of samples	3 Range of densities for the samples gms/cc	4 Mean density gms/cc	5 Weighting factor
Sandstone	29	2.24 - 2.68	2.56	3
Shale	7	2.19 - 2.97	2.53	2
Limestone	9	2.58 - 2.73	2.64	1
Gypsum	3	2.35 - 2.38	2.36	0
Diabase and gabbro	14	2.86 - 3.02	2.94	0

b) Calculation of Rock Density from Seismic Data

The densities of the sedimentary rock layers were also obtained from seismic data in conjunction with the published velocity-porosity and porosity-density curves (Nafe and Drake, 1957). The densities were determined from seismic observations made at five locations, of which two are within the Sverdrup Basin, two near the northern margin of the Sverdrup Basin and one north of the Arctic coastal plain. Using velocity data for each seismic location a porosity was determined for each layer using the porosity-velocity curve of Wyllie, Gregory, and Gardner (1958). The resultant porosity was then used in the porosity-density curves yielding densities for the velocity layers at each location. Table III gives the results and all the pertinent data for each of the five seismic locations. The mean density at each site was obtained by applying a weighting factor in proportion to the thickness of each velocity layer. The results differ somewhat from those obtained from surface samples since the density contrasts are 0.45, 0.21, and 0.13 gm/cc between the basic and the sedimentary rocks, the basement and the sedimentary and the sedimentary and gypsum rocks respectively. This discrepancy undoubtedly reflects errors in both methods and it should be pointed out that the depth to the 20,000-ft/sec layer may include not only the Pennsylvanian and younger rocks of the Sverdrup Basin but also pre-Pennsylvanian rocks. In the subsequent section concerning the interpretation it has been assumed that "basement" represented the pre-Pennsylvanian rocks that are equivalent to the 20,000-ft/sec velocity layer.

TABLE III

Calculation of Rock Density from Seismic Data

Location	Velocity ft/sec	Depth in feet to each velocity layer	Density gm/cc	Mean density at location gm/cc	Mean density for each region gm/cc
Isachsen					Sverdrup
° '					Basin
103 23.9 W	16,300	3,900	2.44)	2.48	
78 45.3 N			)		
	18,000	4,200	2.48)		
	20,000	5,600	2.70 assumed	)	
				)	2.49
East of Cape					
Nathorst	14,000	3,900	2.40)		
			)		
99 1.5 W	16,300	9,000	2.44)	2.50	
78 3.1 N			)		
	18,000	18,000	2.58)		
	20,000	40,000	2.70 assumed		
Prince Gustaf	5,000	0	1.03 sea water		
Adolf Sea	10,000	780	2.10)		
			)		
105 24.0 W	15,000	2,520	2.40)	2.33)	Margin of
78 52.5 N	20,000	7,700	2.70 assumed	)	Sverdrup
				)	Basin
Deer Bay	5,000	0	1.03 sea water	)	
	7,000	500	1.80)	)	
104 24.0 W	15,000	1,470	)	2.33)	2.33
78 52.5 N			2.40)		
	20,000	8,820	2.70 assumed		
North of Cape	5,000	0	1.03 sea water		
Isachsen	6,500	1,040	1.75)		
			)		Arctic
	8,000	3,500	2.00)		Coastal
105 55.5 W			)	2.17	Plain
79 40.0 N			)		2.17
	15,000	8,240	2.40)		
	20,000	15,950	2.70 assumed		

GENERAL DISCUSSION OF THE GRAVITY ANOMALY FIELD

The results of the observations made in 1960 and 1961 within the area outlined in Figure 1 are presented in the form of a gravity map (in pocket) at a scale of 1:500,000 or approximately 1 inch equals 8 miles. The Bouguer anomaly for each station has been plotted in gravity units (1×10^{-4} cgs units) and isoanomaly lines drawn at intervals of 50 gravity units or 5 mgals. For the sake of clarity, detail stations within the Isachsen area, on the Meighen Island Icecap and around the gypsum domes were included only in sufficient numbers to outline the larger gravitational features.

The data reduction was performed by an electronic digital computer employing a standard density of 2.67 gms/cc for the earth's crust and using the International Ellipsoid of 1930 to remove the latitude effect. Using this density rather than a density of 2.56 gms/cc as obtained from surface sampling a small error equivalent to 0.14 mgals per 100 feet of elevation is introduced. In the absence of detailed relief data and since the topography of the western Arctic is relatively flat, terrain corrections have not been applied.

From the map (in pocket) it is readily seen that the gravitational field is highly variable throughout the area. In fact, so disturbed is the field and so steep the horizontal gradients that it is impossible to define precisely the boundary between anomalies. As would be anticipated there is no single dominant trend throughout the map area, but in the northern half of the map the anomalies possess a strong northeast strike which becomes less well defined to the southwest. The total observed change in anomaly within the region is about 112 mgals, varying from -51.6 mgals over Axel Heiberg Island to 60.8 mgals in the Peary Channel Region. The mean Bouguer anomaly for the map area is about 8 mgals and the average rock elevation, including the sea areas, is approximately minus 600 feet, suggesting that the area as a whole is essentially in isostatic equilibrium.

Considering the map in more detail there are at least four major anomaly trends that are readily discernible. These are the Arctic Ocean Low, the Isachsen High, the Sverdrup Basin Low and the Cornwall High. As no distinct boundary can be drawn between the different anomalous zones any dimensions given below are necessarily arbitrary.

The Arctic Ocean Low appearing in the northwestern corner of the map averages 40 miles or more in width and, although continuous contains two distinct centres of low anomaly. The first, located north of Cape Isachsen has a minimum value of -13 mgals and the second, centred off the northwest coast of Meighen Island, has a minimum of -12 mgals. The northeast-trending Isachsen High, immediately to the southeast of the Arctic Ocean Low, averages 50 to 60 miles in width and extends eastward from Prince Gustaf Adolf Sea across the northern part of Ellef Ringnes Island and Peary Channel and appears to terminate over the western side of Axel Heiberg Island. There are several distinct centres located along the length of the anomaly with the maximum value of about 60 mgals occurring off the east coast of Ellef Ringnes Island over the Peary Channel. To the south, the Isachsen High grades into the Sverdrup Basin Low, which consists of a series of distinct pockets of negative anomaly. As can be seen from the map this group of lows is wrapped around the nose of the Cornwall

High which strikes northwest and is centred over Amund Ringnes Island. It is not certain whether the Sverdrup Basin Low continues east of Massey Sound, but lower gravity values in the Kanguk Peninsula region of Axel Heiberg Island may represent its eastern extension. The axis of the Cornwall High itself is more or less coincident with that of the geological feature known as the Cornwall anticline. The anomaly is approximately 30 miles in width and the peak observed value, 36 mgals, is located south of Cape Sverre.

GENERAL GEOLOGY

The area under consideration lies within the structural province of the Sverdrup Basin and the Arctic coastal plain (Figure 2). The Sverdrup Basin (Thorsteinsson and Tozer, 1960) is a major synclinorium extending from eastern Prince Patrick Island across Axel Heiberg Island to Alert on northern Ellesmere Island. The basin is bounded on the south and east by the Franklinian miogeosyncline and on the north by the associated eugeosyncline and the Arctic coastal plain. The latter lies on the northeasterly continuation of the Prince Patrick plain. Another major tectonic feature lying to the south of the area of the Sverdrup Basin considered here is the north-trending Cornwallis fold belt.

Exclusive of the Sverdrup Basin these tectonic features were deformed in early to mid-Palaeozic movements. The development of the Sverdrup Basin commenced with deposition of shallow-water sediments in the mid-Pennsylvanian which continued through to the early Tertiary. Limestone and evaporites (gypsum and anhydrite) are prominent in the late Palaeozoic formations which form the oldest beds in the basin and are now exposed along its flanks. Apparently they also underlie much of the central axis. Above the Palaeozoic beds the basin is filled almost exclusively with clastic sediments. Successive formations comprise a repetitive succession of shale, siltstone, and sandstone, with minor calcareous siltstone, clastic limestone, conglomerate, coal, and volcanic rocks. Many of the rocks are poorly consolidated. Several formations are dominantly shale in the axis of the basin and pass laterally into sandy and conglomeratic material near the margins.

The Sverdrup Basin suffered moderate to severe folding in Tertiary time and within the map region the dominant structures are northwesterly trending anticlines and synclines with undulating axes that produce a very complicated outcrop pattern. The deformation of the Sverdrup Basin has also resulted in the diapiric intrusion of gypsum from beds of Pennsylvanian-Permian age. Several such intrusions of gypsum and anhydrite are now exposed which cut rocks several thousands of feet higher in the stratigraphic sequence and bear fragments of many of the formations through which the intrusion has passed. These diapirs have commonly deformed the beds through which they have risen, locally producing sharp folds and dome-like structures that are superimposed on the regional folds. Some of the better known of these local structures, the Isachsen Dome, the Dumbbell Dome, and the Malloch Dome are shown on Figure 2.

A belt about twenty miles wide trending northeast across Ellef Ringnes Island in the vicinity of Isachsen is characterized by abundant intrusions of gabbro and diabase (Heywood, 1956). The most conspicuous and widespread of these intrustions are sills, commonly 50 to 300 feet thick, in the gently deformed lower Cretaceous shales. There are also about fifteen circular or strongly arcuate structures, in some cases with associated radial dykes, that apparently involve igneous intrusion of basic dioritic to gabbroic composition. Considerable vertical movements are indicated by the presence in some cases of rocks within the ring that are older than those outside. Dykes and sills of similar rocks occur on Cornwall Island, eastern and northern Amund Ringnes Island, and on the Fay Islands. No ring-like structures have been observed in these areas.

The Arctic coastal plain overlaps the northwestern edge of the Sverdrup Basin and in the area under consideration includes about 600 square miles of northwestern Ellef Ringnes Island and all of Meighen Island. It is underlain by a single formation, the Beaufort formation, of unconsolidated sands and gravels considered to be late Tertiary or Pleistocene in age.

CORRELATION OF BOUGUER ANOMALIES WITH GENERAL GEOLOGY

a) Introduction

Considering the gravity map with regard to geological data it is readily seen that there is a marked correlation between surface geology and Bouguer anomaly. The zones of low anomaly are associated with depressed portions of the basement filled with low-density sedimentary rocks. The highs may be correlated with positive basement features in places accompanied by basic intrusives. Superimposed upon these major features are anomalies that may be related with local structures such as gypsum diapirs. In the subsequent discussion the term basement is regarded as crystalline rock of mid-Palaeozoic age or older that has a density 2.70 gms/cc and a seismic velocity of 20,000 ft/sec.

To clarify the interpretations discussed below, the profiles of Figures 4, 5, 6, 7 and 8, whose locations are shown on the gravity map, have been constructed to relate geological and gravity data. The thicknesses given in the diagrams are based on the densities obtained from both surface sampling and seismic work. This not only emphasizes that depth calculations from gravity data are sensitive to the densities assumed, but also indicates the magnitude of the variation that might be expected with a change in density assumptions. The anomalies in the profile have been split into regional and residual anomalies and the calculations made using the assumption of an infinite sheet for regional effects and a segment chart (Hubbert, 1948) for residual anomalies. All thicknesses of sedimentary strata are quoted relative to a thickness of 7,700 feet obtained from seismic measurements made over Prince Gustaf Adolf Sea.

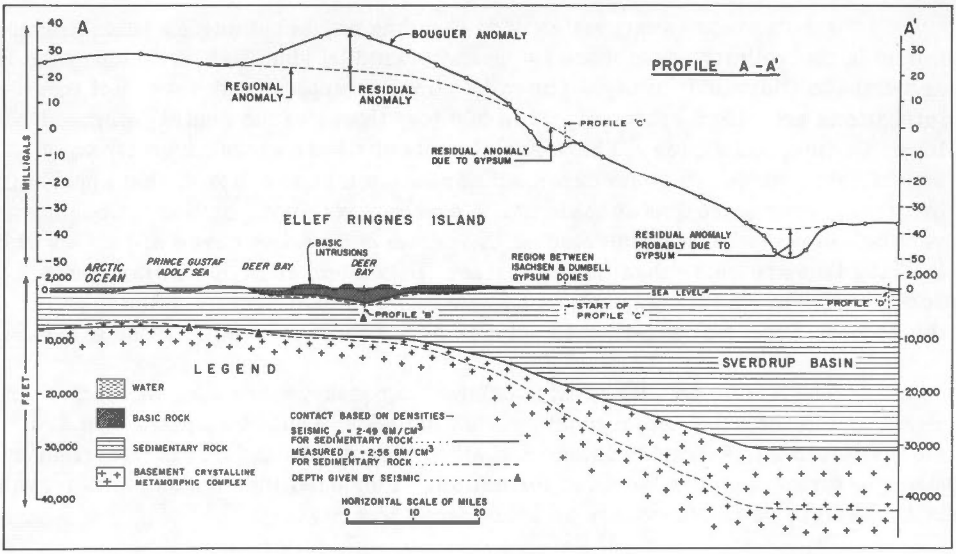

Figure 4. Bouguer anomalies and structural interpretation along profile A-A[1]

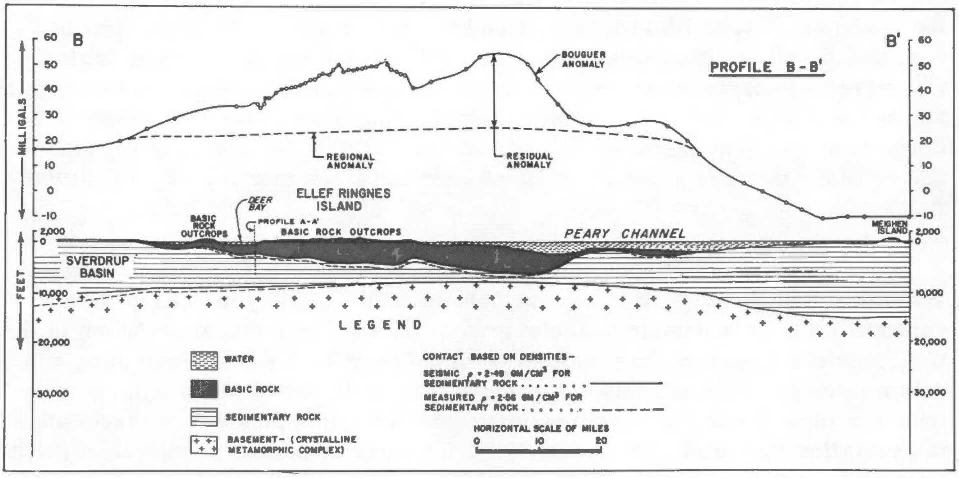

Figure 5. Bouguer anomalies and structural interpretation along profile B-B[1]

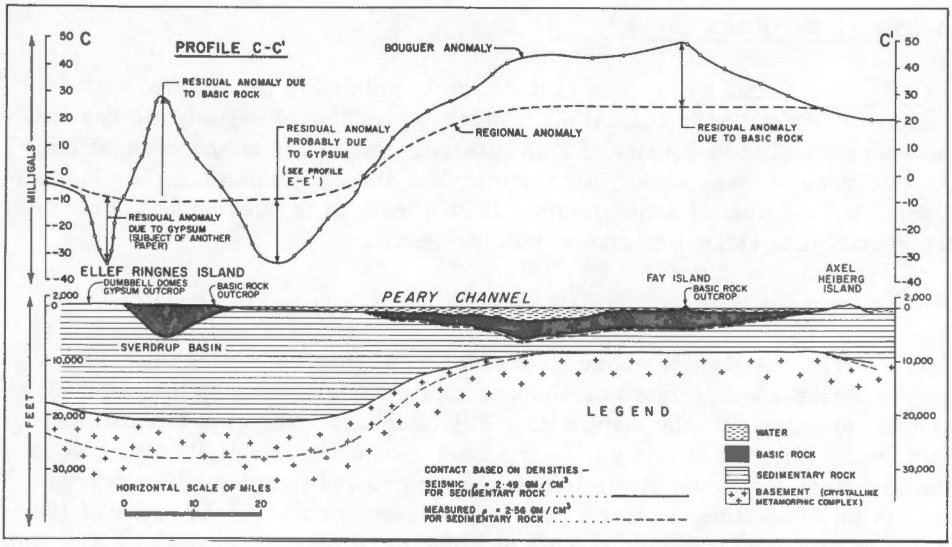

Figure 6. Bouguer anomalies and structural interpretation along profile C-C[1]

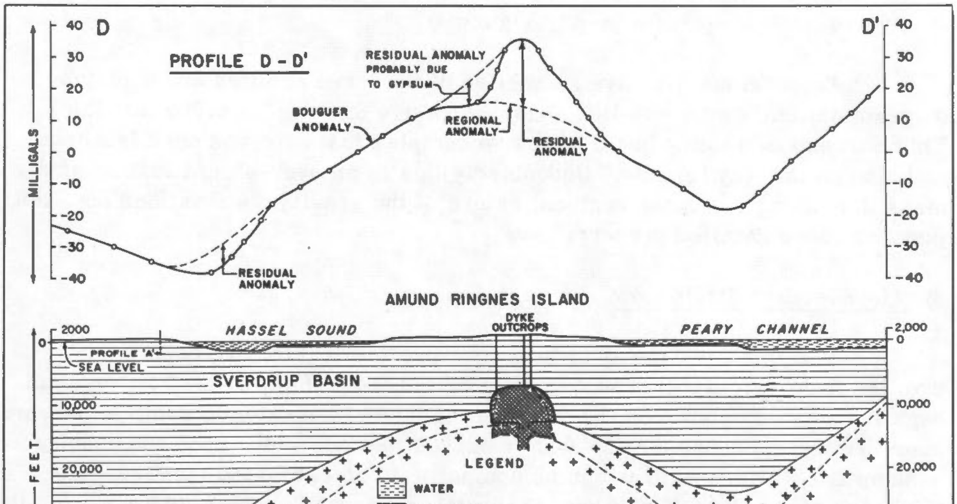

Figure 7. Bouguer anomalies and structural interpretation along profile D-D[1]

b) The Arctic Ocean Low

The Arctic Ocean Low is undoubtedly related to the unconsolidated sediments of the Arctic coastal plain which, according to the seismic results, have a relatively low density of 2.33 gms/cc. Very little is known regarding the thickness of these rocks, but seismic data along the axis of the low indicate a depth to basement of approximately 16,000 feet. It is interesting to note that the gravity data (Figure 5) give a similar result.

c) The Isachsen High

This anomaly is shown on profiles A-A' (Figure 4) which is taken across strike, B-B' (Figure 5) which is approximately along strike and C-C' (Figure 6) which cuts the feature near Fay Island. As shown in the profiles this broad, positive anomaly is interpreted to be caused partially by a rise in the basement rocks and partially by a basic intrusive complex. The gravity data in these profiles suggest a very broad basement arch of the order of 100 miles in width and buried to a depth of 7,000 to 10,000 feet throughout its extent. To the north the arch grades into the Arctic Ocean basin as depicted on profile B-B' in the vicinity of Meighen Island. To the southeast it gives way to the Sverdrup Basin (profile A-A', Figure 4).

The residual positive anomalies of the three profiles are explained diagrammatically by a sill-like, basic intrusive mass up to 4,000 feet thick. This corresponds to the basic intrusive complex that outcrops near Isachsen and also on the Fay Islands. Undoubtedly this is an over-simplification of the mass distribution, but the regional nature of the gravity observations does not justify a more detailed presentation.

d) The Sverdrup Basin Low

The U-shaped group of lows forming this feature are depicted in profiles A-A' (Figure 4), C-C' (Figure 6) and D-D' (Figure 7). The regional negative anomaly shown on the diagrams indicates a maximum depth to basement over the Sverdrup Basin of 30,000 or 42,000 feet depending upon the density assumption. These figures can be compared to an estimated stratigraphic thickness of possibly 40,000 feet (Thorsteinsson and Tozer, 1960, p.22) for the sediments in the Sverdrup Basin.

As indicated earlier the Sverdrup Basin Low as seen in plan is broken up into a series of lows that are here attributed to concentrations of low-density gypsum within the sedimentary section. While it is beyond the scope of this paper to present a detailed analysis for each case the following example, taken from the Haakon Fiord anomaly (profile E-E', Figure 8), indicates the mass distribution required to explain anomalies of this type. In profile E-E' the residual anomaly corrected for regional trend has a maximum anomaly change of 26 mgals with the average horizontal gradient approximately equal to 3 1/2 to 4 mgals/mile. Approximating the disturbing mass to a vertical cylinder of radius 12,500 feet and height 25,000 feet the anomaly can be explained using a density contrast between gypsum and the host sediments of 0.20 gm/cc. Such a cylinder modified (using a segment chart) to fit details of the observed anomaly

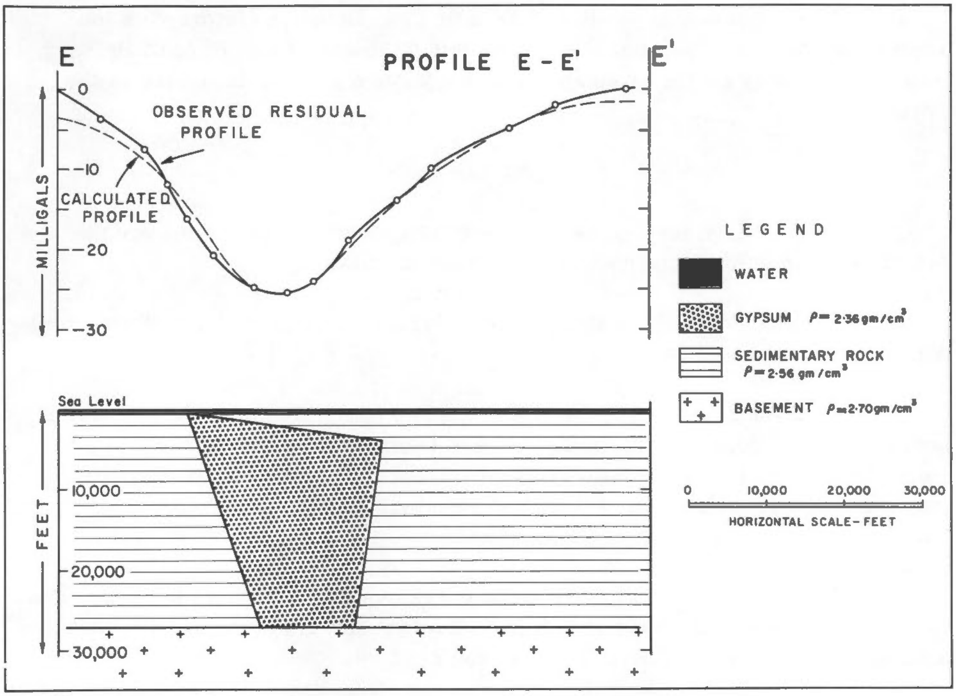

Figure 8. Bouguer anomalies and structural interpretation along profile E-E[1]

is shown in Figure 8. The suggested shape approximates that of some known gypsum domes and although other typical diapir shapes are possible care must be taken, when postulating other models, to satisfy the requirements of the horizontal gradients. The model suggested in Figure 8 is somewhat larger than is usual for known gypsum domes, but the size of the disturbing mass could be decreased substantially through increasing the density contrast. In passing, it is interesting to note the anomalies observed over the suggested diapir structures here are of the same magnitude as those found over the salt domes off the coast of Louisiana in the United States.

e) <u>The Cornwall High</u>

Like the Isachsen High this anomaly, shown in profile D-D' (Figure 7), is explained here by a basement arch and a basic intrusive complex. The arch is approximately 50 miles wide and rises 18,000 to 28,000 feet above the base of the Sverdrup Basin. The central portion of the arch coincides with the axis of Tertiary folding known as the Cornwall anticline (Map 14, 1959). This anticline is accompanied by a complex of basic dykes as well as gypsum piercement features. The presence of basic dykes along with the sharp, positive, residual anomaly shown in the profile suggests a large, underlying intrusive complex.

While discussing profile D-D' a further feature of interest is the suggestion that the basement also rises under the east coast of Axel Heiberg Island. This may be the western limb of a feature similar in nature to the Cornwall arch.

CONCLUSIONS

This preliminary review of the gravity work carried out over the Sverdrup Islands has produced the following results.

1. The Bouguer anomaly field is highly variable and correlates well with known geological features.

2. Two areas of low regional Bouguer anomaly correspond to thick sections of low-density sediments. These anomalies occur over the Arctic coastal plain where the Beaufort formation outcrops and over the Sverdrup Basin where as much as 40,000 feet of Pennsylvanian to Eocene sediments may occur.

3. Two regional gravity highs correspond to basement arches. The broader Isachsen arch rises to within 7,000 feet and the narrower Cornwall arch to within 12,000 to 14,000 feet of the surface.

4. Residual Bouguer anomalies superimposed upon regional trends are interpreted as caused by basic intrusive complexes in the case of positive anomalies while negative anomalies are attributed to gypsum intrusions.

5. The positive anomalies indicate that the basic complexes of Ellef Ringnes Island and the Fay Islands may be continuous along the Isachsen High.

6. Calculations using a density contrast of 0.20 gm/cc suggest that large masses of gypsum are required to satisfy the residual negative anomalies in the Sverdrup Basin region.

7. The mean Bouguer anomaly for the region is -8 mgals suggesting that the area as a whole is in isostatic equilibrium.

ACKNOWLEDGMENTS

The writer acknowledges with thanks the help of the gravity observers from the Dominion Observatory; R.K. McConnell, R. Hornal, and Dr. J.R. Weber. Thanks are also due to R.M. Eaton for the water depths, to T. Overton, G. Hobson and Dr. G. Sanders for the seismic data, and to Dr. M.J.S. Innes, Dr. E.F. Roots, M.R. Dence, J.G. Tanner, and A.C. Hamilton for assistance in producing this paper. Thanks are also tendered to W. Reinhardt, for collecting rock samples for density measurements.

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