DEGLACIAL CHRONOLOGY AND UPLIFT HISTORY: NORTHEASTERN SECTOR, LAURENTIDE ICE SHEET

Arthur S. Dyke

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Occasional Paper No. 12

INSTITUTE OF ARCTIC AND ALPINE RESEARCH • UNIVERSITY OF COLORADO

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Arthur S. Dyke

Institute of Arctic and Alpine Research
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Boulder, Colorado 80302

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ABSTRACT

Using data contained in published literature and the Radiocarbon Data Bank of the Institute of Arctic and Alpine Research, an isochrone map is constructed which describes the pattern of deglaciation of the northeastern sector of the Laurentide Ice Sheet from the time of the late Wisconsin maximum (8000 yr to 8500 yr B.P.) to the present. The change in area and volume of the Northern Baffin Island Ice Cap from 7000 yr B.P. to the present is calculated using the isochrone map and two models relating ice area to volume. The volume measurements are then used to determine the contribution of the ice cap to world sea level rise since 7000 yr B.P.

Based on 325 shoreline locations, radiocarbon dated between 250 yr and 8750 yr B.P., eight isobase maps of the study area are produced depicting the amounts of uplift accomplished since 8000 yr B.P. and 1000 yr intervals thereafter. The pattern of isobases on the 8000 yr B.P. surface shows good agreement with the outline of the late Wisconsin terminal position. The 7000 yr B.P. and younger surfaces show the land recovering around five semi-independent uplift centers over the Queen Elizabeth Islands, Southampton Island, southeastern Keewatin, western Quebec and northern Baffin Island. These uplift centers correspond to late-glacial centers of retreat.

The change in geometry of the uplift surface over northern Baffin Island is analyzed in detail and is found to be a function of the rate of decay of the Northern Baffin Island Ice Cap. Graphs derived from manipulations of the isochrone and isobase maps describe this functional relationship.

Finally the duration and amount of residual rebound at the regional center of uplift over Southampton Island is predicted on the basis of the measured displacement of isobases between 8000 yr and 1000 yr B.P. It is suggested that rebound in that area will be complete within the next 4000 yr resulting in a further 48 m or less of uplift.

ACKNOWLEDGEMENTS

My interest in this topic was generated largely through discussions with Dr. J. T. Andrews, whose continued encouragement and assistance contributed greatly to this thesis. I thank Drs. J. D. Ives and J. C. Harrison for the careful reading and constructive criticism. This work was supported in part by grant number 20883 from the National Science Foundation. Funds for computer programming were provided by the Graduate School of the University of Colorado. Very frequent discussions with fellow graduate students, R. S. Bradley, J. A. Clark, J. H. England and G. H. Miller proved most beneficial.

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CHAPTER 1

INTRODUCTION

AREA AND OUTLINE OF STUDY

The primary aim of this thesis is to produce information on changing ice loads from the time of the late Wisconsin maximum to the present and the accompanying responses of the earth's crust to these changes. This is done through investigation of published reports on the glacial history and Quaternary deposits of the study area. It is anticipated that this information will be subsequently used in geophysical analysis of crustal and mantle rheology. Because the most valid test of a geophysical uplift model lies in the degree to which it predicts or reproduces an actual situation, it is necessary to provide a comprehensive (though interim) review and analysis of the field data. The northeastern sector of the area formerly covered by the Laurentide Ice Sheet was selected for this analysis because a greater amount of information, in the form of radiocarbon dates on ice marginal positions and relative sea-level stands (440 out of 835 dates for Laurentide North America), exists for this area than for any other.

A map of isochrones on the retreat of late Wisconsin ice is provided for the area between latitudes 62° and 74° N and longitudes 60° and 90° W. A series of isobase maps depecting the amounts of uplift accomplished since 8000 yr B.P. and successive 1000 yr intervals thereafter portray crustal response to the process and pattern of deglaciation. The boundaries of these maps are 58° and 76° N latitude and 60° and 100° W longitude. Methods of construction of the isochrone and isobase maps are discussed in chapters 2 and 3 respectively.

Further treatment of the data is largely restricted to the effect of late ice over Baffin Island on glacio-isostatic movements toward isostatic equilibrium in that area and to the prediction of the amount of residual recovery at an uplift center over Southampton Island.

PREVIOUS STUDIES

Isochrones have been drawn on the disintegration of late Wisconsin ice in North America by Bryson et al. (1969) and Prest (1969). Andrews (1970b, 1973a,b) and Walcott (1972) published maps of postglacial rebound for Laurentide North America but their small scale is not commensurate with the detailed treatment in this thesis. Otherwise only local isobases have been drawn (Løken 1962; Andrews, 1970a; Blake, 1970; Andrews et al., 1970). For the sake of brevity reference to individual field studies will be reserved for later relevant sections.

RADIOCARBON DATA BANK

This study was made feasible and greatly expedited by the existence at the University of Colorado Computing Center of a data bank containing information on dated material relating to changes in sea level in North America. It was compiled by J. T. Andrews, G. H. Miller and A. Street in 1971/72 as part of a project funded by the National Science Foundation (Grant 20883).

The radiocarbon data bank is one "set" of data within the TAXIR system and currently consists of 1044 items, 835 of which pertain to Laurentide North America. An estimated 150 dates have to be added because of the continuing publication of dates in the issues of Radiocarbon (no. for 1973). Because the general TAXIR system has been described elsewhere (Brill, 1971) only a brief description of the radiocarbon data bank is given below.

The primary function of the data bank is to facilitate rapid information retrival by the writing of simple programs, the body of which consists of a query or series of queries written in the "near English" language of boolean algebra. Data "items" within the bank are divided into 16 subsets, each defined by a "descriptor". Each descriptor, in turn, consists of a number of elements or "descriptor states". Table 1-I lists the 16 descriptors currently applied to the data bank and examples of corresponding descriptor states. The list, in fact, comprises one item in the response to the following query:

```
PRINT:(SAMPLE NO.,LAB NO.,LATITUDE,LONGITUDE),
(C14 DATE,STANDARD ERROR,MATERIAL DATED,INFERRED RELIABILITY OF DATE),
(UPLIFT,ELEVATION OF SAMPLE,INFERRED RELATIVE SEA LEVEL),
(ELEVATION OF LOCAL MARINE LIMIT,DATE ASSOCIATED WITH MARINE LIMIT),
(RELATION.TO ICE MARGIN,DISTANCE.FROM MAXIMUM ICE MARGIN),
(REFERENCE)

FOR ITEMS WITH LATITUDE, FROM 6200 TO 7400 AND LONGITUDE, FROM
6000 TO 9200*
```

The above query was designed to produce a printout of all information in the data bank relating to the area between the geographical coordinates specified (see Appendix for date list). The location of parentheses within the PRINT statement specifies the number of lines used in the response for each item. For example

TABLE 1-I

Descriptors of the Radiocarbon Data Bank with corresponding examples of descriptor states.

	Descriptor	Descriptor State
a	Sample no.	26
b	Lab no.	GSC1638 (Geological Survey of Canada)
c	Latitude	6756 (67°51' N. latitude)
d	Longitude	6603 (66° 03' W. longitude)
e	C14 date	8410 (14C yr B.P.)
f	Standard error	340 (yr.)
g	Material dated	SH (Shell)
h	Inferred reliability of date	Fairly Sure
i	Uplift	58 meters (=k+eustatic correction)
j	Elevation of sample	34 meters
k	Inferred relative sea level	37 meters
l	Elevation of local Marine limit	43 meters
m	Date associated with marine limit	No
n	Relation to ice margin	Ice nearby
o	Distance from maximum ice margin	---
p	Reference	Miller Up (unpublished)

the first line appearing in the response to the above query will read:

26 GSC1638 6756 6603

Following lines of descriptor states of the same item will be successively justified 4 columns to the left.

The first descriptor appearing in the query determines the ordering of the response. The response generated by the above statement will list items in order of increasing "sample no." size. Thus, if the items in the response are to be printed in order of increasing age, the descriptor, C14 DATE, must be placed first.

The last line of the query beginning with the boolean expression FOR is the limiting statement on the size of the response. However, when used in conjunction with the expression SAME, the response can be expanded and divided into useful classes. An example would be:

```
PRINT:(C14 DATE,LATITUDE,LONGITUDE),
(REFERENCE)
FOR ITEMS WITH C14 DATE FROM 7750 TO 8250
PRINT:SAME FOR ITEMS WITH C14 DATE FROM 7250 TO 7750
PRINT:SAME....
PRINT:SAME FOR ITEMS WITH C14 DATE FROM 250 TO 750*
```

This query will generate a printout of the descriptor states of the specified descriptors listed in order of the magnitude of the radiocarbon date for successively younger 500 year intervals.

The preceding description of the TAXIR radiocarbon data bank is by no means complete and is merely meant to illustrate the application of the system to the problem at hand and its potential as a time saving tool.

CHAPTER 2

CHRONOLOGY OF GROWTH AND DECAY OF THE ICE SHEET OVER FOXE BASIN AND BAFFIN ISLAND

LAST INTERGLACIAL AND EARLY WISCONSIN EVENTS

Known deposits ante-dating the late Wisconsin are predominantly restricted to the outer coastal areas of Baffin Island and Northern Labrador (Fig. 2-1). These deposits and their relation to the late Wisconsin ice margin are discussed in the following section and elsewhere (Andrews and Ives, 1972; Andrews et al., 1972a,b); Miller and Dyke, 1974).

Terasmae et al. (1966) provide the only detailed description of pre-Wisconsin terrestrial interglacial deposits from north-central Baffin Island. Along the upper reaches of the Isortoq River, near the northern end of the Barnes Ice Cap, occur several outcrops of plant-bearing beds overlain by a thin deposit of till. Organic materials from these beds have been radiocarbon-dated > 40,000 yr B.P. and the contained fossil assemblage indicates that prior to their deposition the climate was warmer than present, probably similar to the present climate of southern Baffin Island. The beds have, therefore, been assigned an interglacial age, to which has been applied the name Flitaway Interglacial (Andrews, 1968). It has not yet been possible to definitely correlate them with deposits from the southern margins of the Ice Sheet.

Nappe structures within the beds have a westward orientation suggesting that they were overridden by ice from the east. On this basis, it has been argued that the Laurentide Ice Sheet in this area grew somewhere to the east of these outcrops and flowed toward

Foxe Basin where it coalesced with ice flowing in the opposite direction from Melville Peninsula and northeastern Keewatin. Subsequently, an ice dome became established over Foxe Basin with accompanying radial outflow (Ives and Andrews, 1963). That ice flowed eastward and northeastward over Baffin Island and westward over Melville Peninsula is supported by an analysis of the carbonate content of the fine fractions of 36 till samples from these areas (Andrews and Sim, 1964).

Shell fragments have been collected from till in central-northern Baffin Island (Andrews, 1968) and along the southeastern coast (Blake, 1966). These shells were transported by ice flowing from Foxe Basin and through Hudson Strait, respectively, Reliable dating of these shelly tills may prove very valuable in establishing a chronology of the initial growth of the Laurentide Ice Sheet about which very little is presently known. It is worthy of note, however, that most attempts to develop geophysical models of late- and post-glacial rebound proceed on the assumption that equilibrium depression had been achieved prior to the onset of unloading (cf. Brotchie and Sylvester, 1969). Before this assumption can be confirmed or rejected it is necessary that the early history of the ice sheet be elucidated.

LATE WISCONSIN MAXIMUM

As early as the late 1800's geomorphologists were outlining evidence for a restricted late Wisconsin ice cover on western Greenland (Chamberlin, 1895) and northern Labrador (Bell, 1895; Low, 1896; Daly, 1902; Coleman, 1920). More recently a three-fold vertical weathering and glacial-morphological sequence has been outlined for northern Labrador (Ives, 1957; Løken, 1962).

Mercer (1956) was the first to present evidence of the existence of ice-free areas on Baffin Island during the late Wisconsin maximum. Based on differential degrees of weathering of landforms and the distribution of felsenmeer and partially submerged cirques over Meta Incognita Peninsula (referred to by Mercer as Kingait Peninsula), he concluded that much of the northeastern side of the peninsula and the entire southeast coast of Frobisher Bay seaward of Cape Lawrence remained outside the limits of late Wisconsin ice during the last glacial maximum (Mercer, 1956, p. 557).

This was followed by Løken's (1966) description of old tills and glaciomarine deposits dated > 54,000 yr B.P. from the Cape Aston and Cape Christian forelands. These deposits relate to a sea level about 60 m higher than the postglacial marine limit.

Subsequent dating of "old" shells from Henry Kater peninsula (King, 1969) and Remote Peninsula (Ives and Buckley, 1969) and plant material from the Bruce Mountains near Cape Adair (Harrison, 1964) led to the placing of the outermost portions of 5 forelands along the eastern Baffin coast outside the late Wisconsin ice margin on the Glacial Map of Canada (Prest et al., 1967) and Prest's (1969) isochrone map (see also Prest, 1970, p. 697).

Since publication of these isochrone maps, intensive research on Northern Cumberland Peninsula (Pheasant and Andrews, 1972, 1973; Andrews et al., 1972; England and Andrews, 1973; Boyer and Pheasant, 1974) has led to the formulation of a three-fold weathering zonation very similar to that of northern Labrador with which it has been tentatively correlated (Pheasant and Andrews, 1972). During the late Wisconsin maximum ice advanced only to the vicinity of the fiord heads in northern Cumberland Peninsula (with the exception of Okoa Bay) and remained at its maximum along the local equivalents of the Cockburn Moraines (Andrews and Ives, 1972) until about 8000 yr B.P. Such evidence, along with (1) the increasing number of "old" radiometric dates on marine shells collected from their growth positions (See Fig. 2-1), and (2) the near synchroneity of the marine limits along the 70 to 80 km lengths of eastern Baffin fiords, led Andrews and Ives (1972) to suggest that the Cockburn Moraines may mark the maximum late Wisconsin ice stand over all of eastern Baffin Island. Miller and Dyke (1974) in a more expanded discussion arrive at the same conclusion and present a detailed outline of the late Wisconsin ice border. That outline appears here as the 8000 - 8500 yr B.P. isochrone with the area expanded to include northern Baffin Island. The outermost isochrone is not considered to mark the maximum ice stand south of Bernier Bay, although ^{14}C dates > 23,000 yr B.P. on shells from Boothia Peninsula and Somerset Island may well indicate that much of the Gulf of Boothia was free from glacier ice during the last maximum.

Compton (1964) found shells in marine deposits at 270 m (880 ft) above sea level on northern Brodeur Peninsula and speculated that these high shorelines may relate to a period of isostatic depression older than late Wisconsin, and that, therefore, the degree of preservation of the strandlines meant that the area had not been glaciated during the last glacial maximum. Craig (1965) on the basis of the interlobate appearance of the moraines to the north of

Bernier Bay suggested that Brodeur Peninsula carried an independent ice cap during the closing phases of the late Wisconsin. However, if Compton's (1964) interpretation is correct, ice on the Peninsula did not reach sea level in all areas.

CONSTRUCTION OF THE ISOCHRONE MAP (Fig. 2-1)

Three categories of information were used to pinpoint ice frontal positions in both space and time prior to construction of the isochrone map; namely: (a) location and trend of geomorphological features, (b) lichen diameter isophyses, and (c) finite radiocarbon dates.

Major end moraines and ice-marginal drainage channels along with isophyses on the maximum diameters of the lichen, Rhizocarpon geographicum, appearing in published reports were plotted on a single map at an original scale of 1:1,000,000. The R. geographicum isphyses were assigned dates based on a growth rate curve constructed for the region near the northern end of the Barnes Ice Cap (Andrews and Webber, 1964; Løken and Andrews, 1966). Geomorphological features were dated according to their association with radiocarbon dates on terrestrial organic material or marine bivalves, or by interpolation assuming a roughly uniform rate of retreat.

The radiocarbon dates were divided into three classes according to their description in the TAXIR data bank (Chapter 1): (a) ice contact, (b) ice nearby, and (c) ice far away. Dates described as "ice far away" were used only where there exists a scarcity of "ice contact" dates. A total of 314 dates are available for the area.

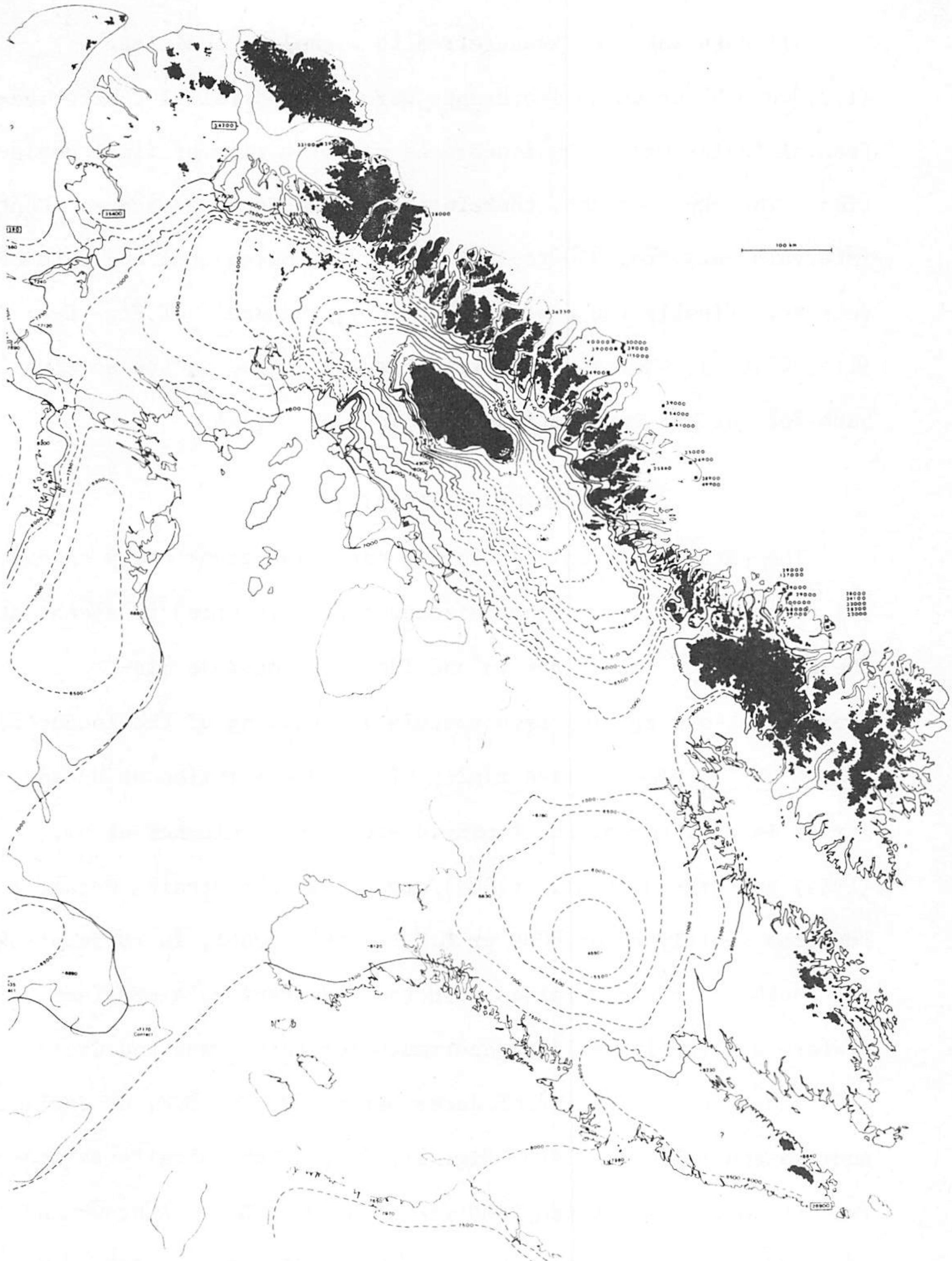

Figure 2-1: Isochrones on the deglaciation of the northeastern sector of the Laurentide Ice Sheet. Contour interval varies from 250 yr to 1000 yr depending upon the rate of retreat and the degree of morphological and chronological control. The locations of ice contact dates from post-glacial deposits (dots) are shown where space permits. The locations along with minimum ages of raised marine deposits which are associated with pre-late Wisconsin ice coverage are shown by solid squares. Dates enclosed by rectangles may or may not be associated with ice transported marine shells.

All data was then transferred to a smaller scale map (1:2,000,000) on which isochrones were drawn parallel to the ice-frontal indicators. The isochrones date the time of final deglaciation. The map does not, therefore, distinguish readvances. Contour intervals vary from 250 to 1000 years, depending upon the rate of retreat. Finally the map was reduced to the scale of Fig. 2-1 (1:5,000,000), whereas the original scale served as the working base for further computations used in this thesis.

PATTERN OF DEGLACIATION

The pattern of deglaciation is portrayed graphically on Fig. 2-1. The following regional discussion is presented to accentuate the main chronological events and identify possible mis-representations arising from speculative placing of the isochrones.

HUDSON STRAIT The precise timing of the deglatiation of Hudson Strait is a matter of continuing discussion. Falconer et al., (1965) and Bryson et al., (1969) argue that the straits became ice-free shortly after 8000 yr B.P. Blake (1966), in correlating the southern Baffin moraines with the Foxe Peninsula moraines prefers a slightly earlier occurrence for this event and Craig (1965) places the opening of James Bay at 7900 yr B.P. or earlier. Andrews and Falconer (1969, Fig. 11) portray the Straits as ice-free at some time between 7800 yr and 8200 yr B.P. Andrews and Ives (1972) conclude that the available radiometric evidence does not permit definitive statements concerning the exact timing of deglaciation.

For the purposes of this paper the exact timing is not of vital importance, as the argument is concerned with the interpretation of only a few hundred years. It is sufficient to note that ice recession in outermost Hudson Strait began about 8800 yr B.P. (Blake,1966), permitting emergence of the York Sound (Frobisher Bay) delta sequence since that time, and that the entire strait and most of Hudson Bay had been deglaciated by 7500 yr B.P. On Fig. 2-1 the 8000 yr B.P. isochrone is somewhat arbitrarily drawn in this region and shows much of the Strait free of ice at that time.

FOXE BASIN Following deglaciation of Hudson Strait the ice retreated rapidly south and southwestward, clearing the whole of the Tyrell Sea (the expanded postglacial Hudson Bay) within a few centuries.

The marine transgression into Foxe Basin was delayed until about 500 to 800 yr later. Dates on the marine limit in Foxe Basin range from 6830 ± 150 yr B.P. (GSC-465) in Bowman Bay, southern Baffin Island, to 6880 ± 180 yr B.P. (GSC-291) on eastern Melville Peninsula and 7170 ± 90 yr B.P. (Gx-1068) on southeastern Southampton Island. These dates indicate that most of Foxe Basin had been inundated by the sea by about 6800 yr to 7000 yr B.P. Perhaps the last area to become ice-free was northern Steensby Inlet where the marine limit has been dated at 6500 yr B.P. from an extrapolated uplift curve (Ives, 1964).

The time of separation of ice over Melville Peninsula from that over northern Baffin Island is problematical as no dates are reported from either side of Fury and Hecla Strait. The strait is, however, shown ice-free at 7000 yr B.P. on the basis of a date of 7120 ± 140 yr B.P. (GSC-307) from the head of Agu Bay.

An ice contact date of 6535 ± 115 (GSC-308) yr B.P. on south-central Southampton implies the existence of relatively late ice there, probably in the form of a small ice cap landward of the limit of the postglacial marine transgression (Bird, 1972).

SOUTHERN BAFFIN ISLAND Blake (1966) concluded on the basis of the latest ice flow pattern and orientation of eskers that the region near the northeastern shore of Amadjuak Lake had been a center of dispersal during the closing phases of the late Wisconsin. It is proposed here that the Southern Baffin Island Ice Cap became separated from the Northern Baffin Island Ice Cap through development of a calving bay which penetrated from Foxe Basin to the head of Cumberland Sound during the early stages of the marine transgression into Foxe Basin about 7000 yr B.P. This is substantiated by a date of 6760 ± 140 yr B.P. (GSC-466) on shells dating the marine limit southeast of Nettiling Lake.

A ^{14}C date of 4550 ± 220 yr B.P. (GSC-498) on basal peat from a site near the southeastern corner of Amadjuak Lake provides a minimum date for the final disintegration of the ice cap.

CUMBERLAND PENINSULA Cumberland Peninsula today contains the 6000 km^2 Penny Ice Cap and numerous other glaciers and smaller highland ice caps. During the late Wisconsin maximum, Laurentide ice was confluent with Penny ice on the western part of the Peninsula but ice cover at that time was not much more extensive than at present (Andrews and Dugdale, 1971; England and Andrews, 1973; Pheasant and Andrews, 1972, 1973; Miller and Dyke, 1974), and the Penny Ice Cap remained the dominant center of dispersal (Andrews et al., 1970). The glaciers of eastern Cumberland Peninsula were probably only slightly expanded from their present state.

Ice retreat on eastern Baffin Island began about 8000 to 8500 yr B.P. and the Penny Ice Cap probably separated from the northern Baffin Island Ice Cap about 1000 yr later. Following this the Cumberland Peninsula glaciers experienced a number of (Neoglacial) advances and retreats (Miller, 1973).

NORTHERN AND CENTRAL BAFFIN ISLAND If the proposed dates of separation of the Penny, southern Baffin Island and Melville Peninsula ice caps are correct, the northern Baffin Island Ice Cap came into existence as a separate entity about 7000 yr B.P. From that time it retreated in a more or less orderly fashion to the present margins of the Barnes Ice Cap in roughly the manner described by Ives and Andrews (1963). The total recession of the northeastern margin has been only 45 to 50 km, an average rate of retreat of about 6 m yr^{-1}. This calculation is based on the assumption that the Cockburn Moraines which are marked by the 8000 yr - 8500 yr B.P. isochrone (Fig. 2-1) were deposited during the late Wisconsin maximum. On Henry Kater Peninsula King (1969) has described fossiliferous marine deposits which have been dated at 10,210 ± 180 yr B.P. (Y-1986), and Andrews et al. (1970) report a date of 9180 ± 180 yr B.P. (Y-1832) on shells dating the marine limit at Cape Hooper. These two dates are among the few from all of eastern Baffin Island which are in excess of 8500 yr B.P. (Andrews and Ives, 1972, Fig. 3) and their precise meaning is not clear. Conceivably they may indicate an earlier date of deglaciation in the Home Bay area but the data is not sufficient to permit construction of isochrones for that time.

The detailed field studies and geomorphological mapping of Ives and Andrews (1963), Sim (1963), Andrews (1963 a and b), Ives (1964 a and b), Andrews and Webber (1964), Andrews (1966), Løken and Andrews (1966), King and Buckley (1967), Andrews (1968, 1970a), and Andrews et al., (1970) provide detailed control on the chronology and pattern of recession of the Northern Baffin Island Ice Cap along its eastern and western margins and in the regions near the Barnes Ice Cap. There is little dating control in large tracts of central Baffin Island and the isochrones there have been drawn largely by interpolation between moraine segments. The pattern outlined by Fig. 2-1 will be radically wrong, however, only if the glacier retreated to more than one center. There is no evidence to date to suggest that this was the case.

COMPARISON WITH OTHER ISOCHRONE MAPS

The major differences between Fig. 2-1 and the isochrone maps of Prest (1969) and Bryson et al.,(1969) are enumerated below:

(1) Both Prest and Bryson et al., have drawn ice marginal positions for times prior to 8500 yr B.P., and thereby suggest that late Wisconsin Laurentide ice extended beyond the outer coast in all but a few regions. Figure 2-1 carries the implication that areas beyond the Cockburn Moraines, with the exception of those highlands which may have carried local glacier ice, were ice free during the late Wisconsin maximum. The location of marine deposits along with their ages which lie outside the Cockburn Moraines and which are associated with mid or early Wisconsin glacial episodes are shown in support of this hypothesis.

(2) The retreat of ice over north-central Baffin Island is shown in a very generalized manner by Prest and Bryson et al. Here an attempt is made to more precisely portray the chronology and pattern of deglaciation and the rate of unloading.

(3) Prest's map shows ice retreating northward over Southampton Island, whereas on the maps of Bryson et al., and this thesis that Island is considered to have been a center of retreat during the late glacial (ca. 6500 yr to 6000 yr B.P.).

TEMPORAL CHANGES IN GLACIATED AREA AND ICE VOLUMES

Several writers have used various methods to calculate the volumes of ice and water contained in Quaternary ice sheets. Paterson (1972) reviewed earlier attempts and used the "speculative" isochrone map of Prest (1969) to calculate changes in area and volume of the Laurentide and Innutian ice sheets from 18,000 yr to 6000 yr B.P.

This present thesis presents area measurements and volume calculations for the Northern Baffin Island Ice Cap from 7000 yr B.P. to the present at 1000 yr time intervals. Although the first two results overlap in time with those of Paterson (1972, Table 5), they are significantly different due to the discrepencies between the two base isochrone maps.

CALCULATION METHODS

Using the isochrone map described earlier in this chapter (scale 1:2,000,000) and a polar planimeter the areas of the Northern Baffin Island Ice Capwere measured for 1000 yr intervals from 7000 yr B.P. to the present. Each area measurement was performed twice and the mean of the two values was chosen as final. The small discrepancies between the two measurements indicate that the final values are accurate within the confines of the map scale (estimated precision ± 3%).

The ice volumes were then calculated as functions of area using the following formulae:

$$V = 7.854 \ (R^2(R^{\frac{1}{2}})) \quad , \qquad (2\text{-}1)$$

where R is the radius (in m) of the ice sheet and V is volume, and

$$\log_{10}V = 1.23 \ (\log_{10}S-1) \quad , \qquad (2\text{-}2)$$

where V is volume and S is area.

Equation 2-1 results from integrating Hollin's (1962) approximation of an ice cap profile (Antarctica) for circular ice caps. Andrews (1970b) pointed out that use of this formula for an elongated ice cap probably results in an over-estimation of volume. The value of R used is the radius of a circle whose area is equal to the area of the ice cap as determined by planimetry.

Equation 2-2 is the regression line of a log-log plot of volume against area for six existing ice sheets (including Antarctica, Greenland and the Barnes ice caps). The standard error of deviation from the line is 0.1 and the volume calculations are probably accurate to within 12% (Paterson, 1972).

RESULTS

Table 2-I and Fig. 2-2 summarize the results of the area measurements and volume calculations described above. It will be noted that the volumes calculated by equation 2-1 are consistently higher than those calculated by equation 2-2, but that the difference

TABLE 2-I

Change in area and volume of the Northern Baffin Island Ice Cap from 7000 yr B.P. to the present.

A	B	C	D	E
Time (Yr.B.P.)	Area 10^3 km^2)	Volume $(v=7.854(R^2R^2)^{\frac{1}{2}})$ $(10^3$ $km^3)$	Volume (log S=1.23(log S-1) $(10^3$ $km^3)$	Diff-erence (%)
7000	140.5	161.80	133.15	17.7
6000	81.0	82.20	62.40	24.1
5000	57.0	52.14	42.15	20.2
4000	37.96	31.95	26.30	17.7
3000	20.88	18.35	12.89	29.8
2000	12.04	7.315	6.53	10.8
1000	7.44	3.921	3.65	6.9
0	6.0	3.170	2.799	11.7

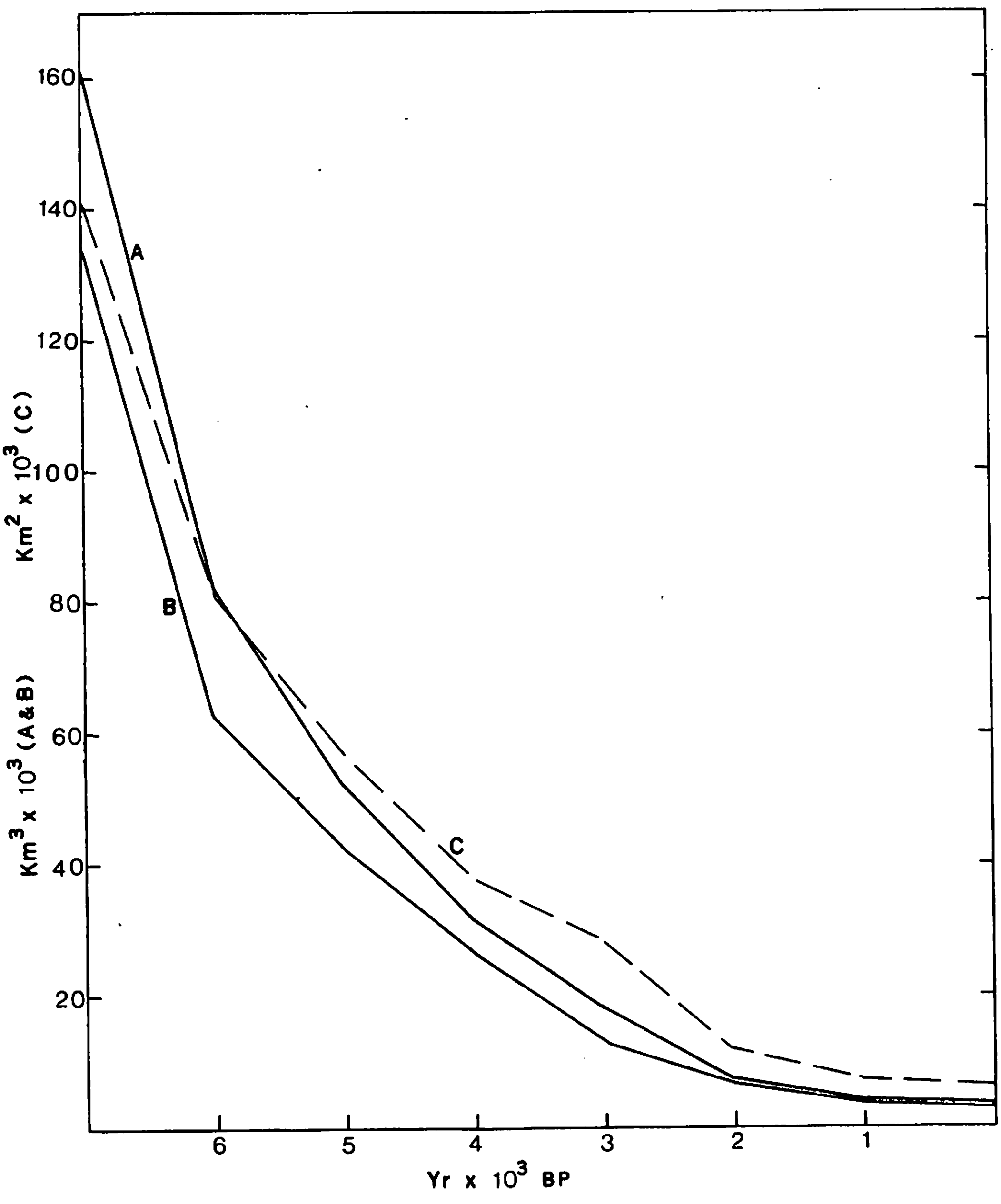

Figure 2-2: Area (by planimeter) and volume (by the two methods discussed in the text) of the Northern Baffin Island Ice Cap from 7000 yr B.P. to the present.

generally diminishes as does the area. Equation 2-1, thus, probably results in an over-estimation of the volumes of elongated ice caps as mentioned previously.

To determine the relative reliability of the two sets of results, the volume of the northern Baffin Island Ice Cap at 5000 yr B.P. was calculated by a different method. The irregular outline of the 5000 yr B.P. isochrone was smoothed to approximate an elipse. The transverse profile of an elliptically shaped ice cap can be described by the following equation:

$$h = (2h_o x)^{\frac{1}{2}} \qquad (2\text{-}3)$$

where h is the height at distance x from the ice edge and $h_o = k(pg)^{-1}$, where k is basal shear stress, p is the density of ice, and g is acceleration due to gravity. If $k = 1$ bar, $h_o = 11.3$ m, and

$$h = (23x)^{\frac{1}{2}} \qquad (2\text{-}4)$$

(Nye, 1952).

From the profile equation the cross-sectional areas under a number of transverse profiles across the ice cap were calculated and the volume derived by integrating. The volume thus calculated for the ice cap at 5000 yr B.P. is 41 $km^3 \times 10^3$, which differs from the value in column D by only 2.6%. This suggests that the values in column D are the more reliable.

Table 2-II lists the contribution to world wide sea level rise which resulted from melting of the Northern Baffin Island Ice Sheet. The total melting that has occurred since 7000 yr B.P. contributed less than 40 cm to eustatic sea level. This leads to the realiza-

TABLE 2-II

Contribution to world sea level rise by the Northern Baffin Island Ice Cap (7000 yr B.P. to present)

A Time (Yr.B.P.)	B($x10^{14}$ m^3) Water content of Northern Baffin Ice Sheet range of values from Col. C & D or Table 2-I	C Contribution (in meters) to world sea level rise since time stated in Column A
7000	1.456 - 1.1984	0.3954 - 0.3250
6000	0.7398 - 0.5616	0.1970 - 0.1486
5000	0.469 - 0.3794	0.1220 - 0.0981
4000	0.2876 - 0.2367	0.0718 - 0.0586
3000	0.1652 - 0.1160	0.0379 - 0.0252
2000	0.0658 - 0.0588	0.0103 - 0.0093
1000	0.0353 - 0.03285	0.0019 - 0.0021
0	0.0285 - 0.0252	0 - 0

B = Ice volume x 0.9

C = Water content at time, t, - Water content of Barnes Ice Cap ÷ Area of Ocean (3.61×10^{14} m^2)

tion that an incipient Laurentide Ice Sheet may reach considerable proportions before its growth would be readily recognizable in the world's marine geological record.

CHAPTER 3

LATE-GLACIAL, POSTGLACIAL AND RESIDUAL REBOUND AND THE RELATION OF REBOUND TO CHANGES IN LOAD

GENERAL STATEMENT

In this chapter, eight isobase maps depicting the amounts of rebound accomplished since 8000 yr B.P. and successive 1000 yr intervals thereafter are presented for the area between latitudes 58° and 76° N and longitudes 60° and 100° W. The uplift pattern as it changes through time is largely controlled by the pattern of deglaciation from the late Wisconsin maximum (see Chapter 2). This relationship is discussed in some detail with particular attention paid to the effect of late ice over Baffin Island in the form of the slowly retreating Northern Baffin Island Ice Cap. Following that, an attempt is made to estimate the amount and duration of residual rebound at the Southampton Island uplift center based on the rate of displacement of the various isobases on the maps toward this center.

CONSTRUCTION OF THE ISOBASE MAPS

For the map area the radiocarbon data bank contains 325 finite dates between 250 yr and 8750 yr B.P. associated with raised marine deposits. These dates were divided into 500 yr class intervals and then subdivided according to the response to the query, "inferred reliability of date", into the following categories:*

-----

*A nominal classification of the probability that the quoted date accurately places in time a strandline of known eleustion.

(a) definite, (b) likely, fairly sure, (c) possibly and (d) small chance.

Table 3-I shows the number of dates in each category for each of the 500 yr class intervals. Dates whose inferred reliability was "small chance" were ignored. However, as can be seen from the table, this did not seriously deplete the amount of dating control available.

Technical problems associated with radiocarbon dating of fossil marine organisms are potentially important in a study such as this. However, no adjustments to the data have been made here as no widely accepted conventions regarding such corrections have yet become established. These problems are discussed in detail by Olsson and Blake (1962), Stuiver and Suess (1966) and Mangerud (1972).

The amount of uplift accomplished since the formation of a dated strandline is

$$U_t = E_s + E_t \qquad (3\text{-}1)$$

where U_t is the amount of uplift that has occurred since time t, E_s is the elevation of a strandline to which a dated sample refers, and E_t is the amount of eustatic sea level rise since time t (considered positive). The value of E_t used here is that supplied by the sea level curve of Mörner (1969).

The values of uplift were plotted on maps with a scale of 1:2,000,000 to allow accurate placing of the data points and careful interpretation of local patterns. Each map utilized data from the nearest of the three class intervals (Table 3-I) in order to extend control to as much of the study area as possible and to provide upper and lower limits on the true values of uplift as well as nearest approximations. This is justified because the class

TABLE 3-I. Inferred reliability of radiocarbon dates for 500 yr class intervals used in construction of the isobase caps.

Date class intervals (yr B.P.x10^3)	Definite No. A	Definite % B	Fairly sure likely No. C	Fairly sure likely % D	Possibly No. E	Possibly % F	Small chance No. G	Small chance % H	Total in class I(Σ_{class})	$\frac{\Sigma_{class}}{\Sigma_{Dates}}$ J
8.25-8.75	6	23.1	14	53.8	1	3.8	5	19.2	26	8.0
7.75-8.25*	16	42.1	17	44.7	3	7.9	2	5.3	38	11.7
7.25-7.75	9	36.0	13	52.0	3	12.0			25	7.7
6.75-7.25*	13	30.9	24	57.1	3	7.1	2	4.7	42	12.9
6.25-6.75	9	32.1	15	53.6	3	10.7	1	3.5	28	8.6
5.75-6.25*	7	36.8	11	57.9	1	5.3			19	5.8
5.25-5.75	5	26.3	13	68.4	1	5.3			19	5.8
4.75-5.25*	7	30.4	13	56.5	3	13.0			23	7.1
4.25-4.75	2	20.1	5	50.0	3	30.0			10	3.1
3.75-4.25*	4	25.0	11	68.8			1	6.3	16	4.9
3.25-3.75	4	20.0	15	75.0			1	5.0	20	6.2
2.75-3.25*	4	28.6	9	64.3			1	7.1	14	4.3
2.25-2.75	2	25.0	6	75.0					8	2.5
1.75-2.25*	2	18.2	7	63.6	1	9.1	1	9.1	11	3.4
1.25-1.75	3	60.0	1	20.0	1	20.0			5	1.5
0.75-1.25*	3	17.6	14	82.4					17	5.2
0.25-0.75	1	25.0	3	75.0					4	1.2
Total in Category and Mean Percentile	97	29.8	191	58.8	23	7.1	14	4.3	325	
	Σ	$\overline{X}$	Σ	$\overline{X}$	Σ	$\overline{X}$	Σ	$\overline{X}$	Σ_{Dates}	

*Periods for which isobases are provided.

interval of 500 yr is approximately equal to the 2 standard deviation error range on either side of the mean quoted value (± 250 yr) of most samples (Appendix). The isobases were then drawn by interpolation so that the upper and lower limiting values fell near isobases of lesser and greater magnitudes, respectively, and the data providing the nearest approximations of the true value of uplift (i.e., data from the median class interval) exerted the greatest amount of control. Figure 3-1 is presented to illustrate this aspect of the construction method.

If isobases for a given time were extended over areas which had not yet been deglaciated (were still ice-covered), it was assumed that no major breaks in slope occurred on the uplift surface. Furthermore it was assumed that a profile along such a surface was similar to but more subdued than a theoretical ice sheet profile. In such cases useful data were supplied from the youngest of the three class intervals for areas that became deglaciated within 500 yr after the point in time represented by the map.

The patterns presented by this series of maps are derived solely from the interpretation of sound field data rather than upon empirically or theoretically derived models. Indeed these are the patterns which geophysical models must explain.

The 1:2,000,000 scale served as the base for further calculations and measurements. The maps were then reduced to a smaller scale for convenience of presentation. For ease of interpretation the land masses appear as featureless blocked plateaus and the isobases as superimposed topographies. The locations of the data points are shown on each map by differing symbols according to the

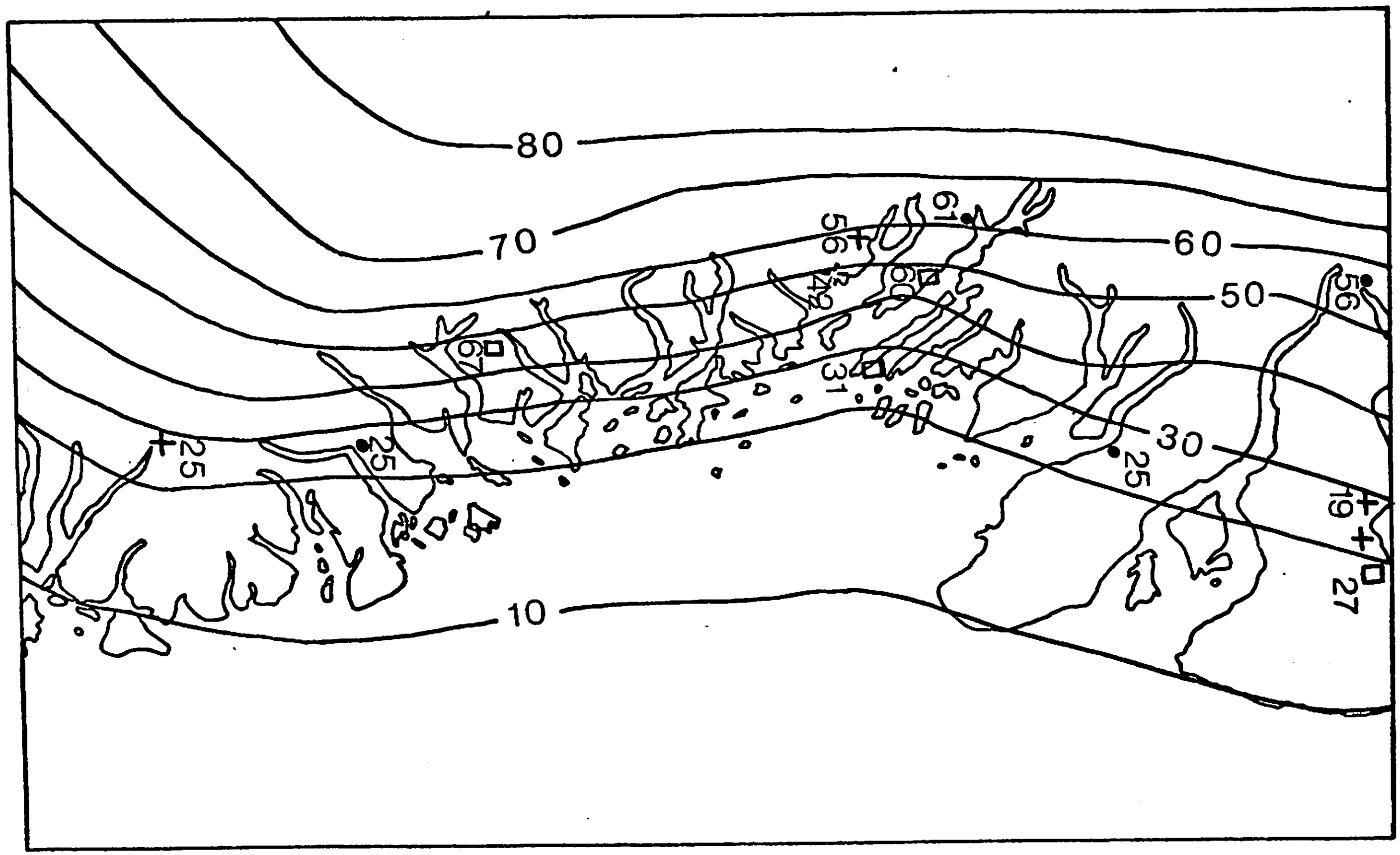

Figure 3-1: A portion of the 7000 yr B. P. uplift surface (Home Bay Area) showing the distribution of data and the method of isobase construction. Solid dots represent locations of strandlines dated between 6750 yr and 7250 yr B.P. Open squares represent locations of strandlines dated between 7250 yr and 7750 yr B.P. Uplift accomplished since 7000 yr B.P. is, therefore, less than the stated values (in meters). Crosses mark locations of strandlines dated between 6250 yr and 6750 yr B.P. Uplift accomplished since 7000 B.P. is more than the stated value. Scale 1:2,000,000. Contour interval: 10 meters.

class interval from which they were chosen. Due to scale reduction these points are not discernable where the isobases are closely spaced.

It is worth noting that although the study area contains the densest distribution of dated samples of any area of comparable size in North America, the sample points are not randomly distributed. For significant areas, especially Ungava Bay, Hall Peninsula, southern and eastern Cumberland Peninsula, Bylot Island, Borden Peninsula and Brodeur Peninsula, as well as much of Keewatin no dating control has yet been provided. Therefore, considering the large scale of the original maps, future field research and new dates may require that corrections of greater or lesser significance be applied on these areas of the map sheets. Nevertheless, the writer feels that the time is ripe for, and a sufficiently strong body of data exists upon which can be based, a useful analysis. This analysis itself will hopefully point to future research problems.

TEMPORAL CHANGES IN THE FORM OF THE UPLIFT SURFACE

THE 8000 YR B.P. SURFACE (Fig. 3-2)

The first in this series of maps depicts the amount of rebound that has been accomplished since 8000 yr B.P., which in several recent papers (Chapter 2) is the proposed date of the late Wisconsin maximum for a large part of the study area.

Because the general outline of the margin of the ice sheet should be reflected, though smoothed, by the isobases on uplift accomplished since onset of deglaciation, and because the outline of the depressed region should continue to generally reflect this limit until several thousand years later, a comparison of the

8000

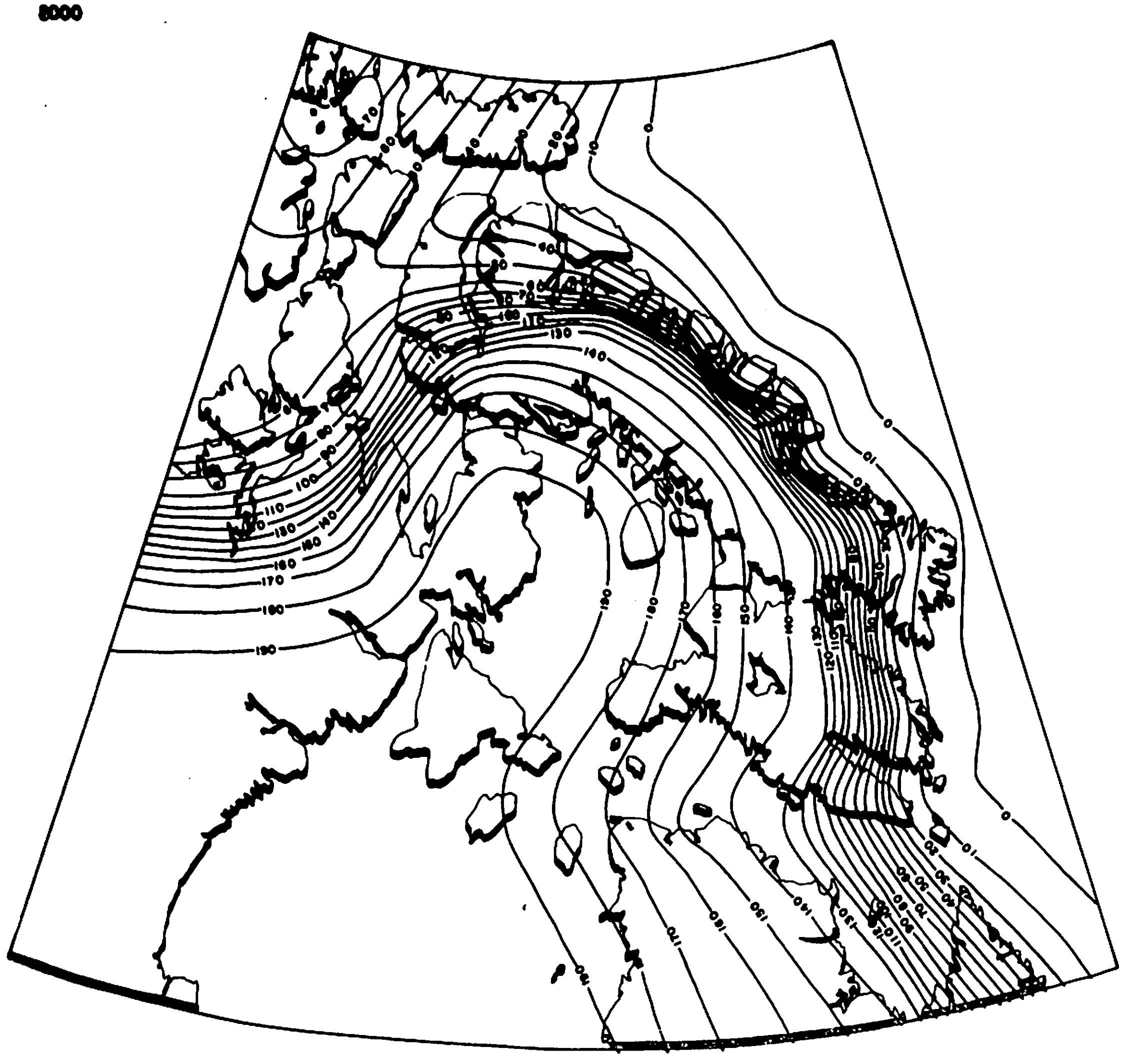

Figure 3-2: Isobases on the amount of uplift accomplished since 8000 yr B.P. Contour interval is 10 meters. Dots mark shoreline locations dated between 7750 yr and 8250 yr B.P. Open squares mark shoreline locations dated between 8250 yr and 8750 yr B.P. Crosses mark shoreline locations dated between 7250 yr and 7750 yr B.P. Some locations are obscured by the contour density.

proposed maximum extent of ice and the isobase pattern on Fig. 3-2 is warranted.

In general the 8000 yr B.P. isochrone (Fig. 2-1) roughly parallels the outermost isobases and is nearly coincident with the 90m and 100m lines. The area over Cumberland Peninsula provides an exception to this which may be an indication that the isobases are incorrectly placed there. Alternately, the low values of uplift and the non-parallelism of the isobases and the ice margin over this peninsula reflects the small amount of glacier retreat (and thus, change in load) that the area has experienced since the last glacial maximum. The peninsula, therefore, is responding to the much greater change in load over areas farther west.

The pronounced embayment of the isobases over Meta Incognita Peninsula and the even more pronounced embayment over northern Baffin Island and Lancaster Sound argue strongly for the hypothesis that the 8000-8500 yr B.P. isochrone marks the maximum ice frontal position. If ice had extended over all or most of Baffin Island to the margins of the continental shelf and then rapidly melted back to the position marked by the 8000 yr B.P. isochrone, one would expect that a great deal of rebound would have remained unaccomplished over the Continental Shelf and that the outline of this extensive ice sheet would be reflected in the isobase pattern. Such is not the case.

The trend of the isobase trough extending southwestward from outer Lancaster Sound roughly follows the 200m isobath as far as southern Somerset Island. During the eustatic minimum sea level was depressed about 120m (Steinen et al., 1973). However, the land surface was also considerably depressed, so that the potential depth of water in Lancaster Sound and Prince Rupert inlet during the late Wisconsin maximum was still nearly 200m (500m in eastern Lancaster Sound as far west as Northern Brodeur Peninsula). This great depth of water likely provided a very effective calving environment which tended to restrict the coverage of glacier ice. Such was also likely the case in Cumberland Sound and Frobisher Bay.

It is proposed that the major depression in the isobases across the northern part of the map sheet roughly divides the areas of dominant influence of the Laurentide and Innuitian (Blake, 1970) ice sheets. This carries with it the implication that Laurentide ice did not extend nearly as far north in northeastern Keewatin as was previously assumed and the Innuitian Ice Sheet extended its influence over at least Somerset and Prince of Wales islands, considerably south of Barrow Strait. The lower gradient on the isobase surface on the northwestern portion of the map suggests that the Innuitian Ice Sheet was much thinner than its southern counterpart. This latter conclusion was also reached by Moran and Bryson (1969) from an independent approach.

One final notable area of coincidence between the isobase trends and the 8000 yr B.P. isochrone is the region between Iterbilung and Sam Ford fiords where a minor seaward protrusion of the ice front produces a fairly noticeable wave in the isobases.

The pattern of contours on Smoothed Free Air gravity anomalies (Walcott, 1970) extending from north-eastern Labrador to Devon Island and Boothia Peninsula is strikingly similar to the isobase trends on Fig. 3-2. The +20 milligal contour is very nearly coincident with the 8000 yr B.P. 20m isobase and the zero milligal contour lies very close to the zero isobase at 1000 yr B.P. (Fig. 3-3).

In consideration of both lines of evidence it seems most unlikely that the peninsulas of eastern and northern Baffin Island were overrun by Laurentide ice during the last glacial maximum.

THE 7000 YR TO 1000 YR B.P. SURFACES

The isobases on the amount of uplift accomplished since 7000 yr B.P. (Fig. 3-4) present a significantly different pattern from that on Fig. 3-2, while thereafter (Figs. 3-5 to 3-10) the pattern changes very little. Although the isobases near the margin of the depressed region maintain trends similar to that on the 8000 yr B.P. surface (that continue to reflect the shape of the maximum ice stand), by 7000 yr B.P. the land is recovering around five semi-independent centers over the Queen Elizabeth Islands, northern Baffin Island, Southampton Island, southeastern Keewatin and western Quebec. This detail is different from the smooth patterns shown by Andrews (1970b) and Walcott (1972) but shows fair agreement with the uplift centers determined by Andrews and Barnett (1972) based on the locations of interceptions of orthoginals to local isobases.

The change in the pattern of uplift from 8000 yr to 7000 yr B.P. is very closely related to the major deglaciation events that occurred between these dates. The embayment along Hudson Strait is more pronounced, extending well into Hudson Bay by 7000 yr B.P. The uplift centers all relate to centers of retreat, providing

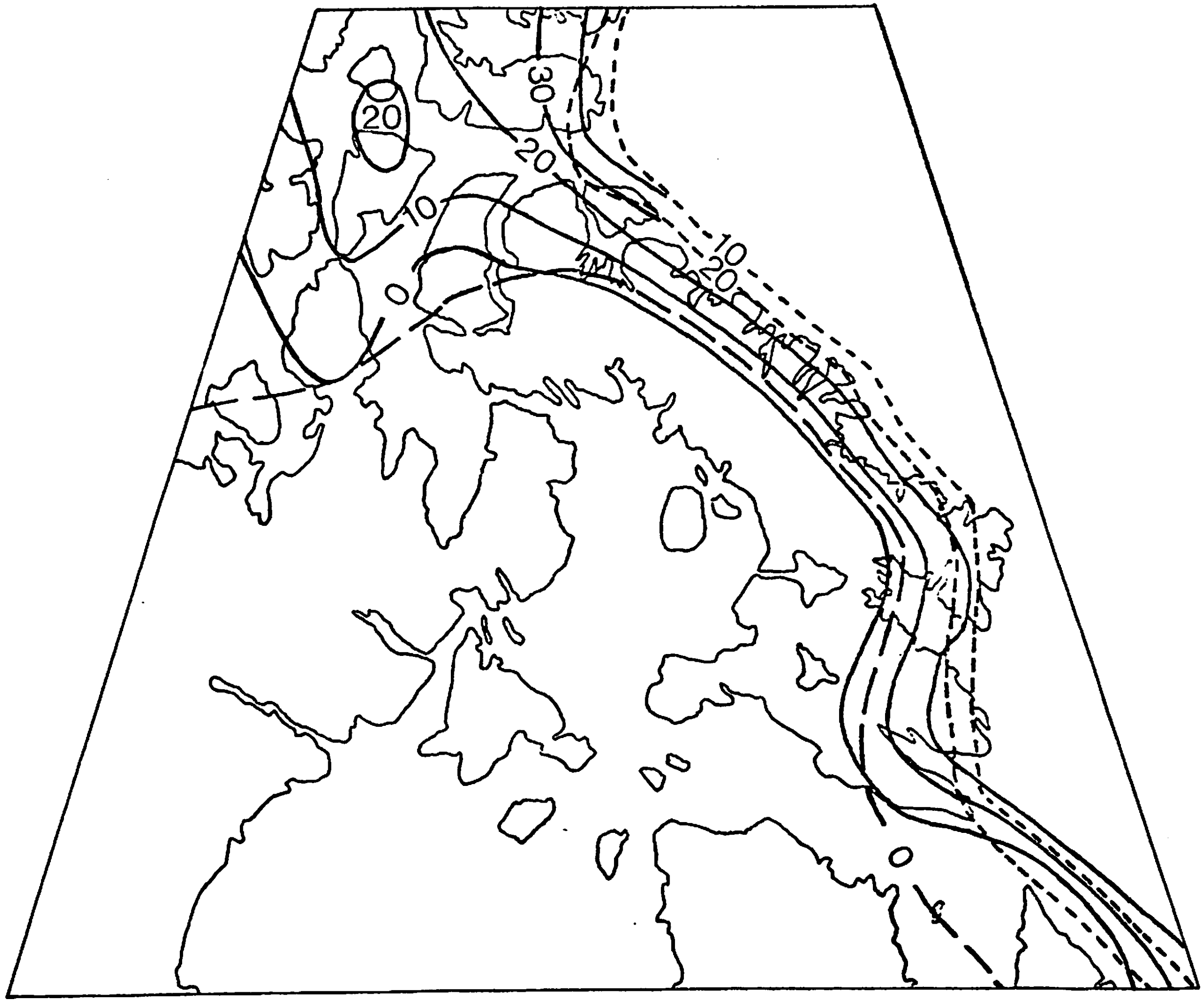

Figure 3-3: A comparison between isobase patterns and the pattern of contours on smoothed Free Air gravity anomalies. Solid lines are gravity anomaly contours in milligals. The short-dashed lines are the 10 m and 20 m isobases from the 8000 yr B.P. surface. The long-dashed line is the Om isobase from the 1000 yr B.P. surface.

7000

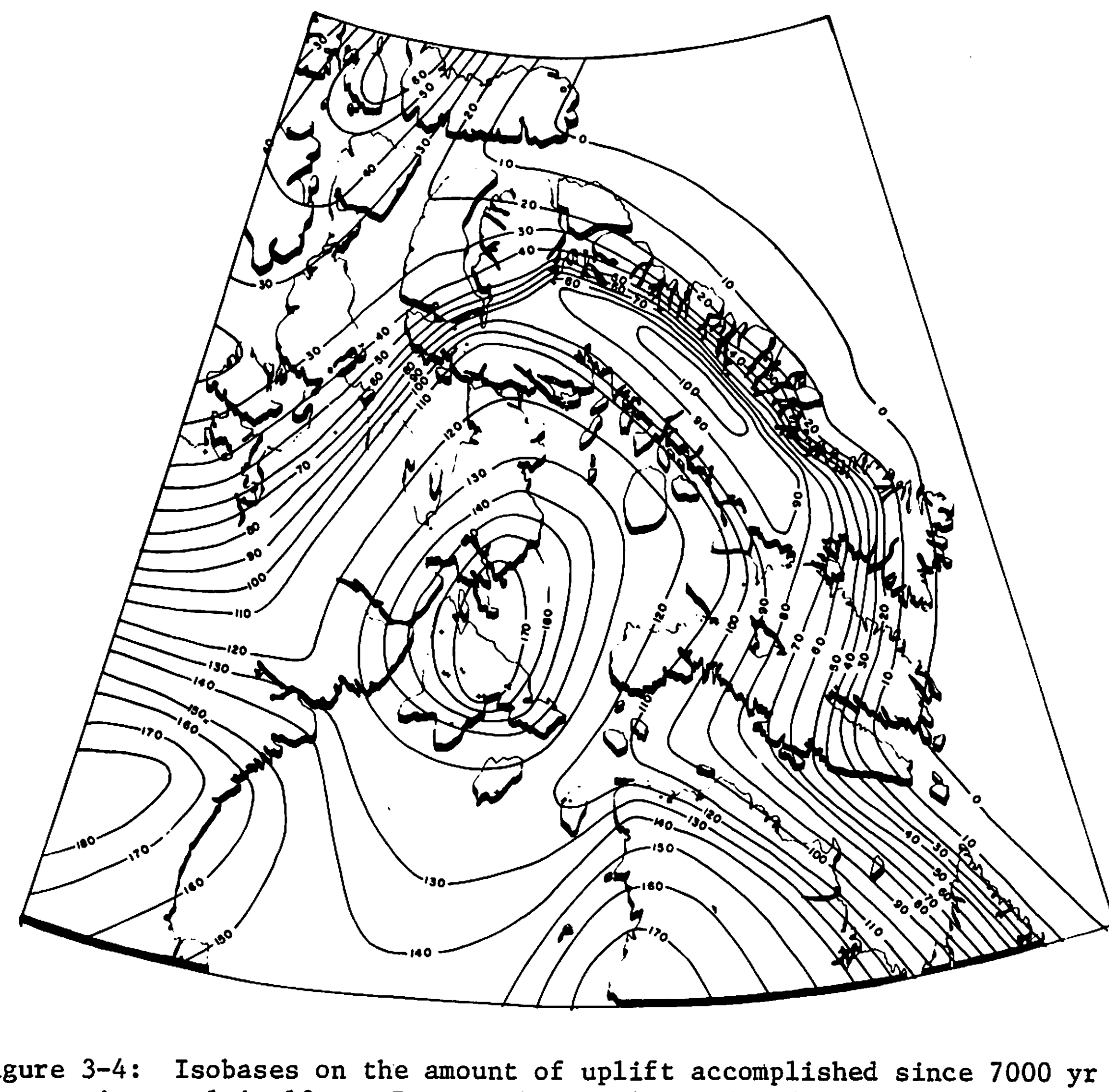

Figure 3-4: Isobases on the amount of uplift accomplished since 7000 yr B.P. Contour interval is 10 m. Dots mark shorelines dated between 6750 yr and 7250 yr B.P. Open squares mark shorelines dated between 7250 yr and 7750 yr B.P. Crosses mark shorelines dated between 6250 yr and 6750 yr B.P.

6000

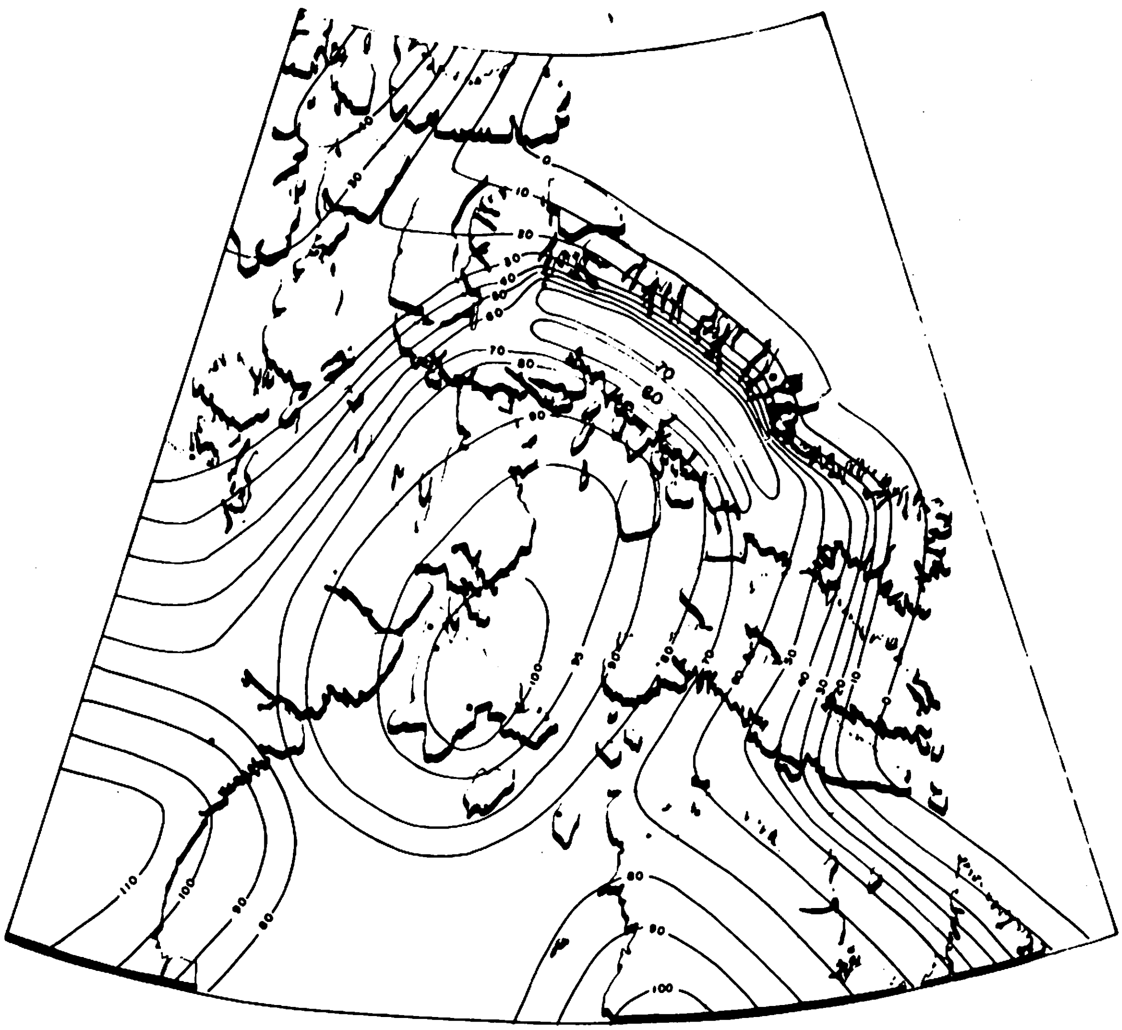

Figure 3-5: Isobases on the amount of uplift accomplished since 6000 yr B.P. Contour interval is 5 meters and 10 meters. Dots mark shorelines dated between 5750 yr and 6250 yr B.P. Open squares mark shorelines dated between 6250 yr and 6750 yr B.P. Crosses mark shorelines dated between 5250 yr and 5750 yr B.P.

5000

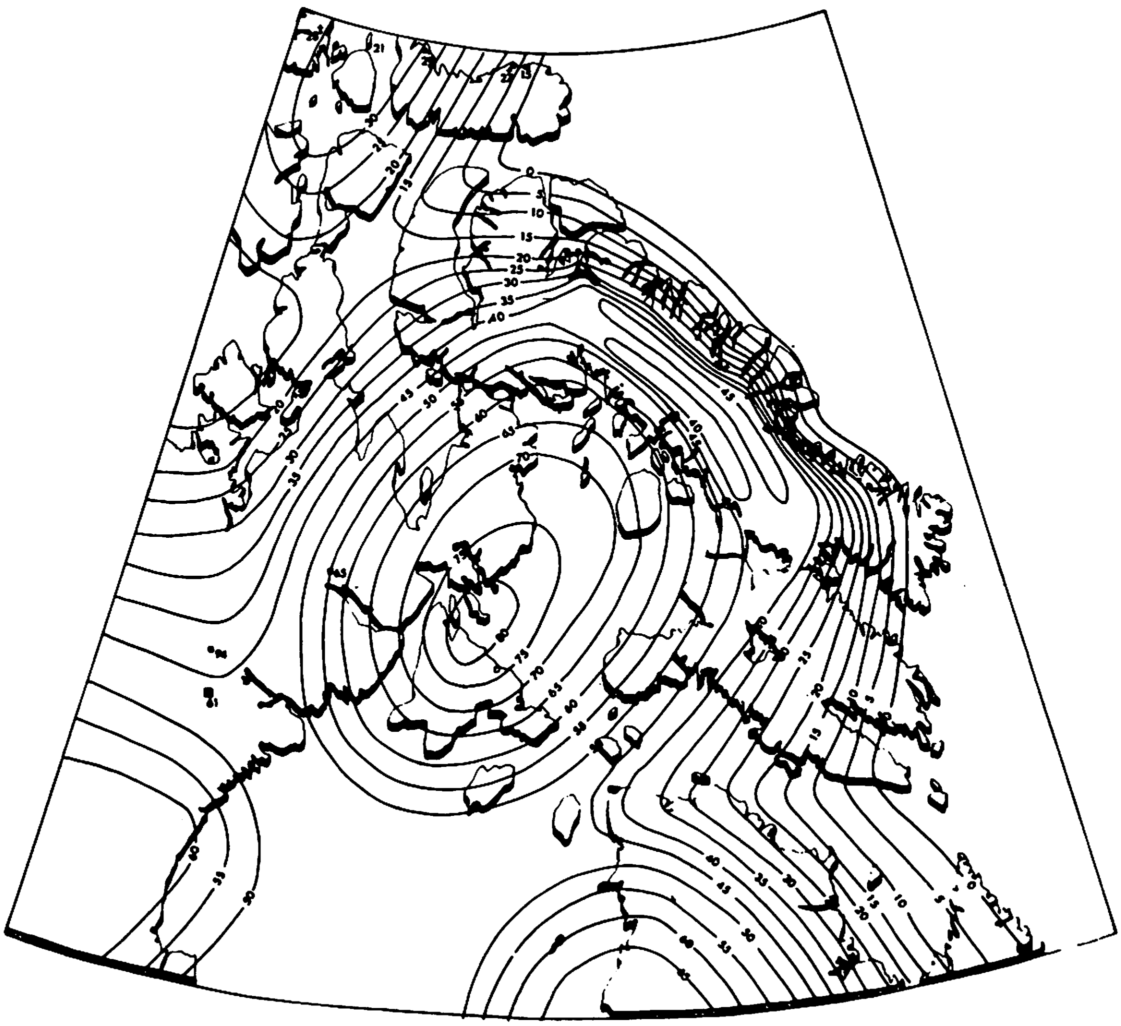

Figure 3-6: Isobases on the amount of uplift accomplished since 5000 yr B.P. Contour interval is 5 meters. Dots mark shorelines dated between 4750 yr and 5250 yr B.P. Open squares mark shorelines dated between 5250 yr and 5750 yr B.P. Crosses mark shoreline dated between 4250 yr and 4750 yr B.P.

4000

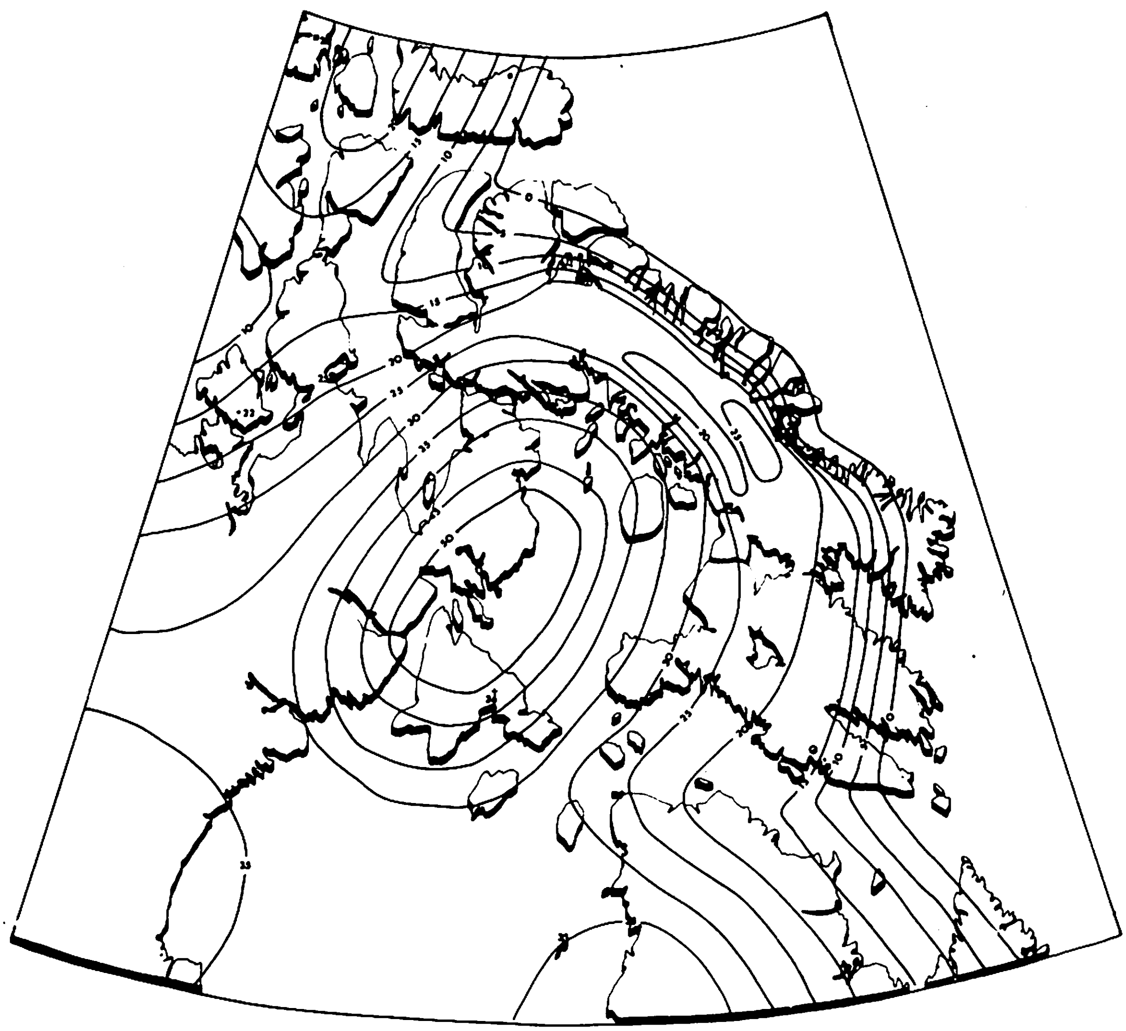

Figure 3-7: Isobases on the amount of uplift accomplished since 4000 yr B.P. Contour interval is 5 meters. Dots mark shorelines dated between 3750 yr and 4250 yr B.P. Open squares mark shorelines dated between 4250 yr and 4750 yr B.P. Crosses mark shorelines dated between 3250 yr and 3750 yr B.P.

3000

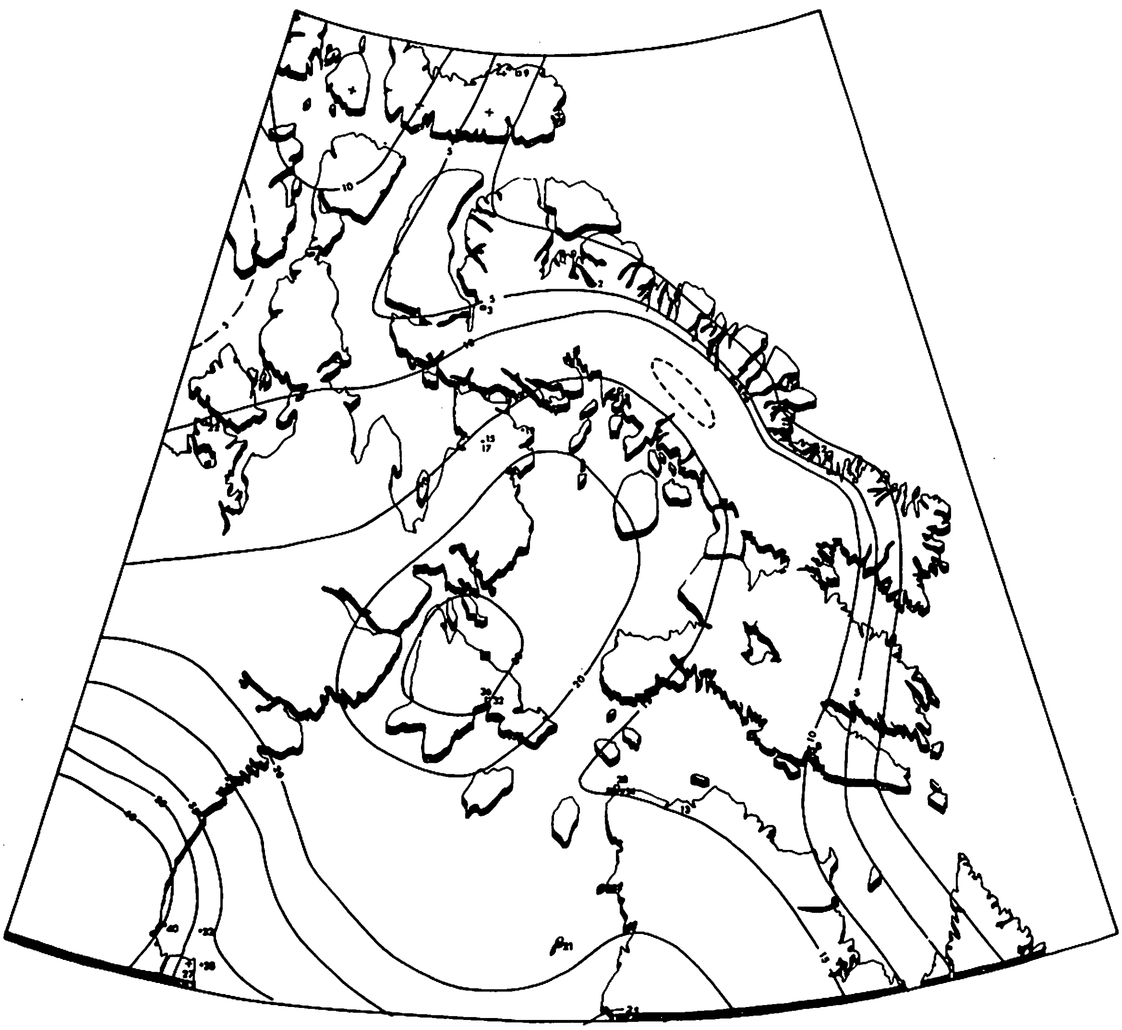

Figure 3-8: Isobases on the amount of uplift accomplished since 3000 yr B.P. Contour interval is 5 meters. Dots mark shorelines dated between 2750 yr and 3250 yr B. P. Open squares mark shorelines dated between 3250 yr and 3750 yr B.P. Crosses mark shorelines dated between 2250 yr and 2750 yr B.P.

2000

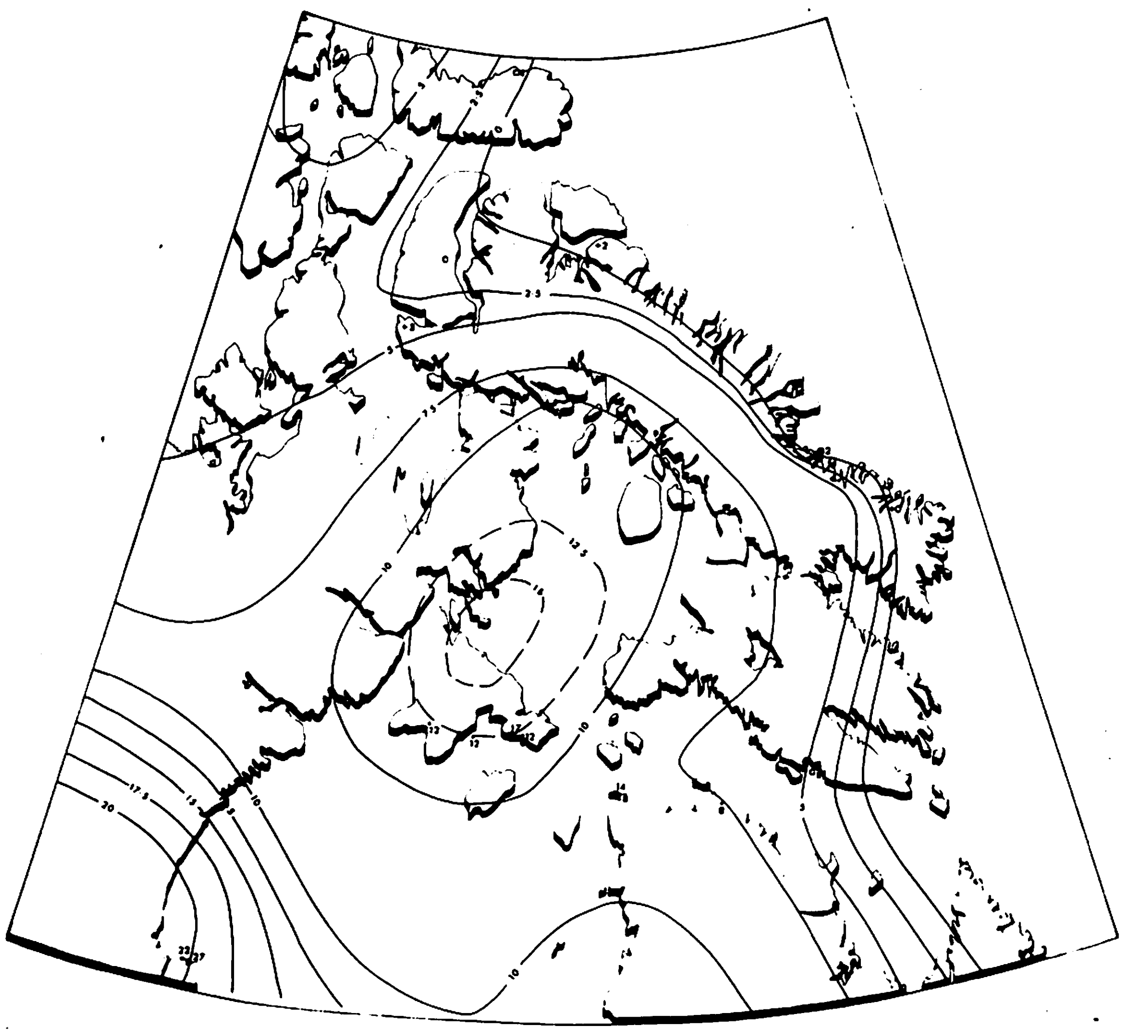

Figure 3-9: Isobases on the amount of uplift accomplished since 2000 yr B.P. Contour interval is 2.5 meters. Dots mark shorelines dated between 1750 yr and 2250 yr B.P. Open squares mark shorelines dated between 2250 yr and 2750 yr B.P. Crosses mark shorelines dated between 1250 yr and 1750 yr B.P.

1000

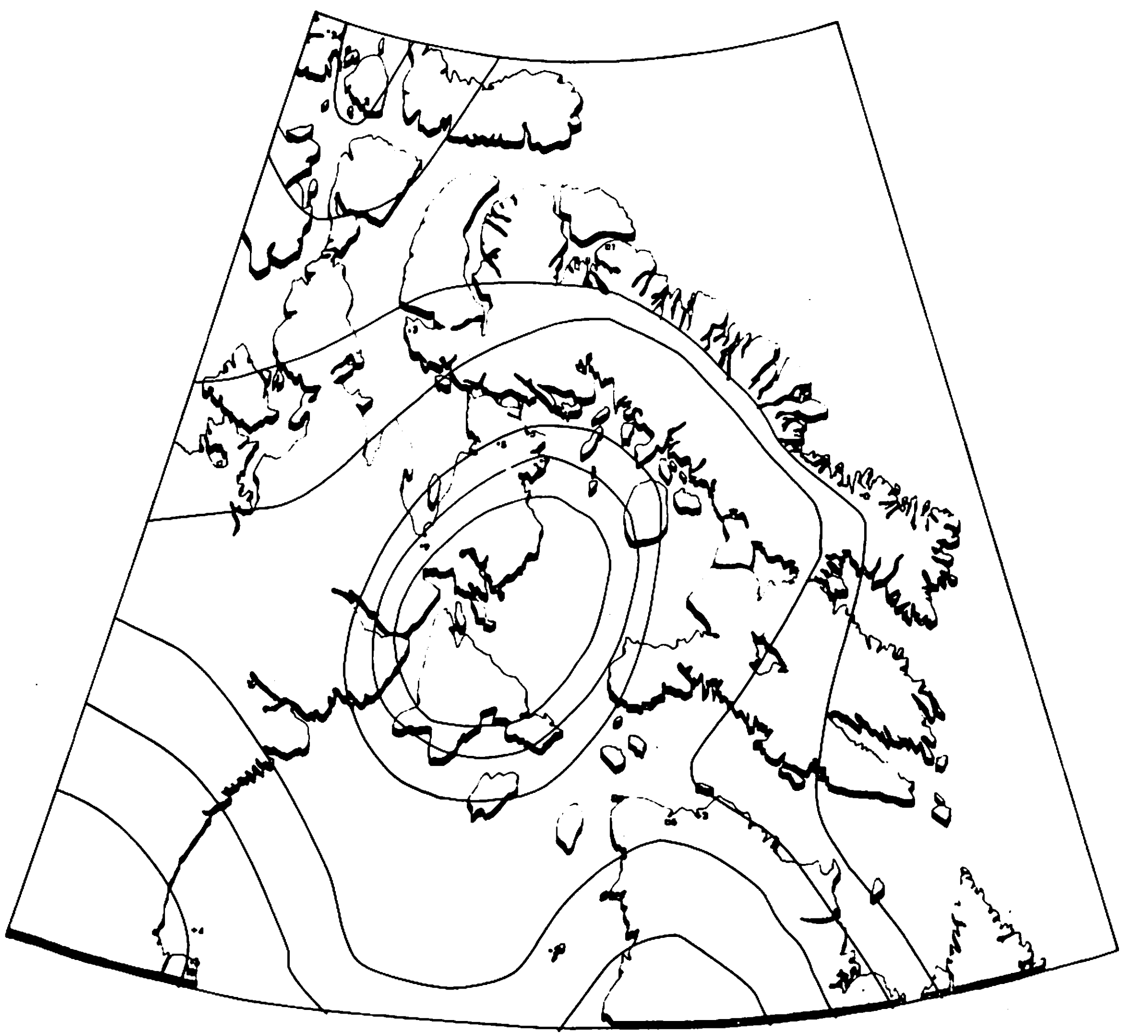

Figure 3-10: Isobases on the amount of uplift accomplished since 1000 yr B.P. Contour interval is 2.5 meters. Dots mark shorelines dated between 750 yr and 1250 yr B.P. Open squares mark shorelines dated between 1250 yr and 1750 yr B.P. Crosses mark shorelines dated between 250 yr and 750 yr B.P.

evidence that the major remnants into which the Laurentide Ice Sheet broke following the catastrophic marine transgressions into Hudson Bay and Foxe Basin acted effectively in restraining the rates of rebound of the underlying mantle. On the other hand, the extremely rapid unloading of great thicknesses of ice from Hudson Bay and Foxe Basin allowed high rates of uplift to proceed unchecked in these areas immediately adjacent to the remnant ice masses. The result of the combination of these two opposing effects upon adjacent areas was to establish and accentuate the various centers of late-glacial and postglacial uplift.

From 7000 yr B.P. to 1000 yr B.P. the amplitudes of the domes on the uplift surface decreases exponentially as the overlying loads of ice decreases.

THE EFFECT OF THE NORTHERN BAFFIN ISLAND ICE CAP UPON THE REBOUND OF BAFFIN ISLAND

EQUIDISTANT DIAGRAMS

Andrews (1970b, Fig. 7-6) demonstrated that synchronous strandlines from the west and east coasts of Baffin Island do not, when projected onto an equidistant diagram, describe a simple curvilinear profile. Figure 3 of Andrews (1973b) documents the same problem. This implies that the Northern Baffin Island Ice Cap exerted a considerable restraining effect upon the area it occupied. Figures 3-4 through 3-10 depict the extent of this effect and show that the shape of the uplift dome closely resembles the shape of the Northern Baffin Island Ice Cap. It is stressed that the isobases over central Baffin Island have been drawn in the only manner that does not conflict with the data yet reconstructs a physically possible surface. Attempts to fit the data by other patterns resulted in either crossing isolines or creation of cliffs in the statistical surface.

The information contained on the isobase and isochrone maps allows a detailed interpretation of the amount of restrained rebound* imposed by changing ice loads. Figure 3-11 presents equidistant diagrams that graphically portray the influence of the Northern Baffin Island Ice Cap upon strandline geometry and the orderly decline in this influence which accompanied thinning and recession of the ice cap. The northern Baffin Island uplift achieved its greatest amplitude and lasted longest in the region of the present Barnes Ice Cap.

The eastern and western margins of the retreating ice cap are shown on the equidistant diagrams. It is obvious that the relationship between the locations of the crests of the ice cap and the strandlines is not simple. The bases of the troughs in the strandline profiles are not located directly under the western ice margins but are displaced toward the longitudinal axis of the ice cap. This is interpreted as a result of the rigidity of the lithosphere which allowed the strong Southampton Island uplift to extend its influence eastward of the deglaciated area. The bases of the strandline troughs represent the points (or axes when viewed planimetrically; Figs. 3-4 through 3-10) which separate the area influenced dominantly by the strong uplift to the west from that dominated by the more protracted

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*Rebound occurring prior to deglaciation of a site.

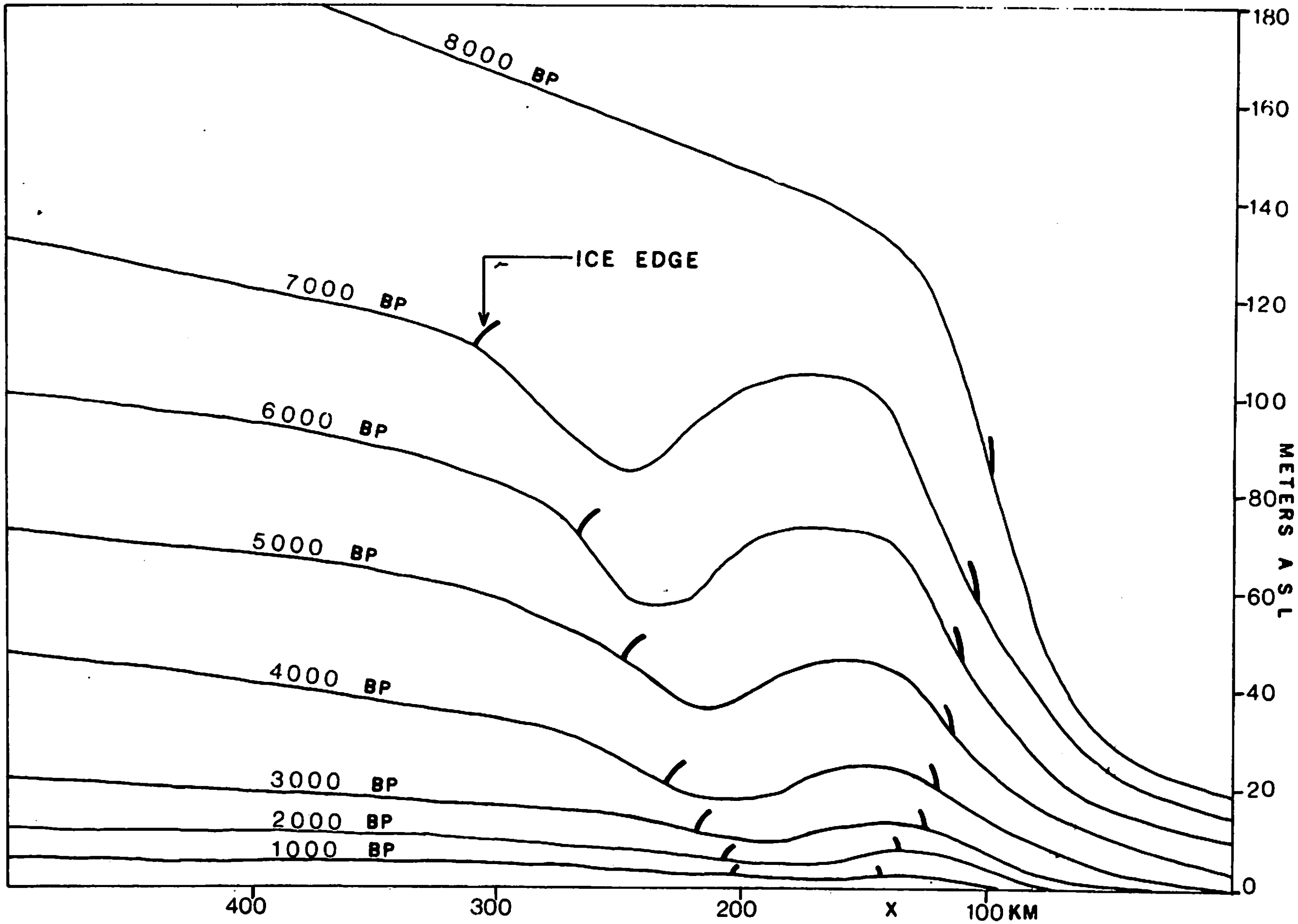

Figure 3-11a: An equidistant diagram constructed from the isobase maps for a profile from Foxe Basin to eastern Baffin Island, running across the Barnes Ice Cap. Vertical exaggeration is 2000 times. See Figure 3-13 for profile location.

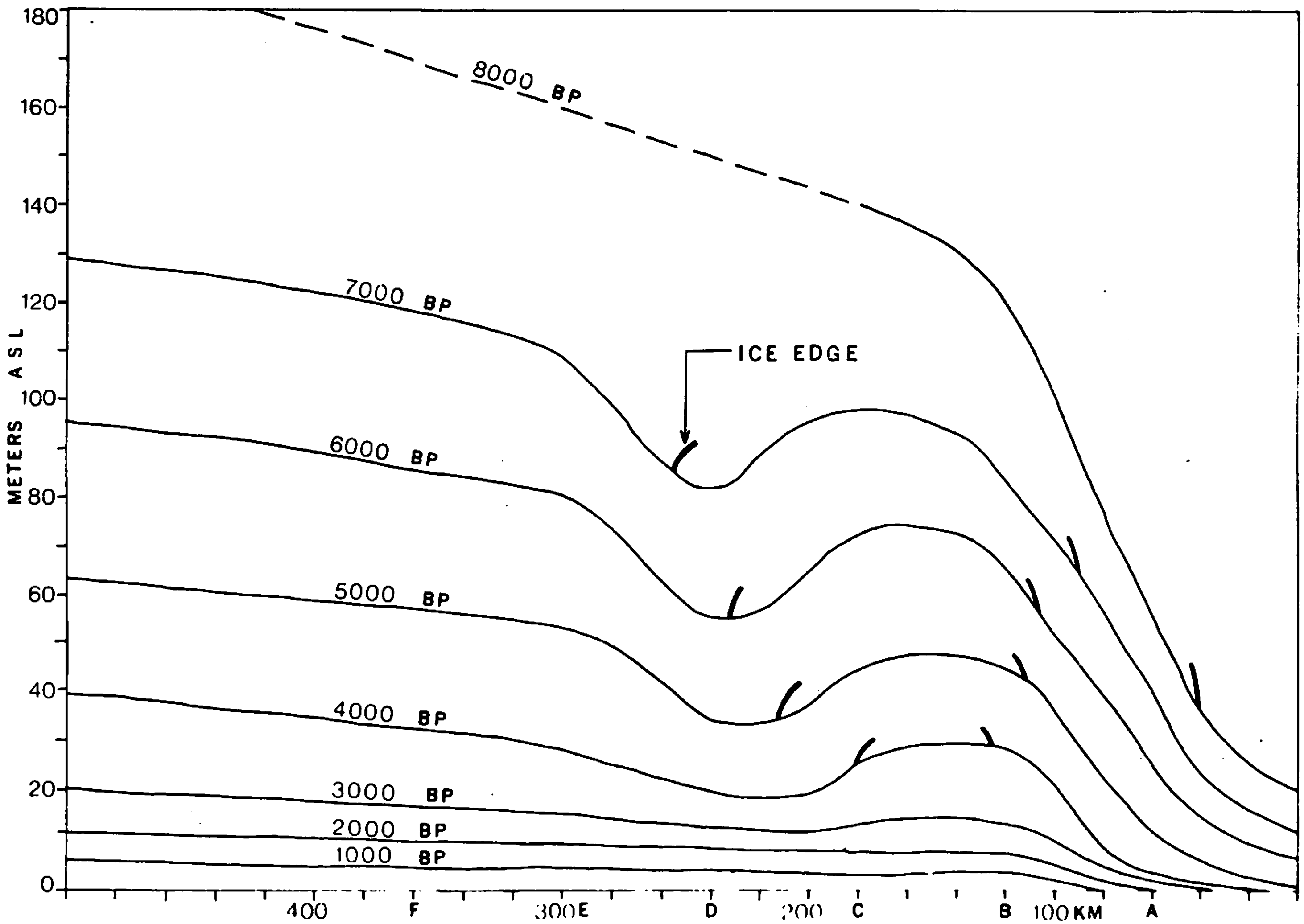

Figure 3-11b: An equidistant diagram constructed from the isobase maps for a profile from Home Bay to Prince Charles Island, Foxe Basin. Vertical exaggeration is 2000 times. See Figure 3-13 for profile location. Points A through F are the locations for which the uplift curves of Figure 3-13 are supplied.

decrease in load to the east. It is evident from the strandline geometries that as the volume of the Northern Baffin Island Ice Cap decreased so did its restraining power, until by 2000 yr B.P. (Fig. 3-11a) almost the entire area under the ice cap came under the dominating influence of the longer wavelength Southampton Island uplift. The northern Baffin Island uplift cannot, therefore, be considered a discrete unit, but rather a regional perturbation within the general Laurentide uplift. This, just as did the other perturbations, resulted from the peculiar, nearly instantaneous, deglaciation of large tracts of central Laurentide North America following the Cockburn-Cochrane phase about 8000 yr B.P. (Falconer et al., 1965).

The amplitude and wavelength of the perturbation were measured for each strandline and plotted on Fig. 3-12. The maximum amplitude was 20m and the half wavelength was 60 km. The rate of decrease in amplitude (curve A) is initially rapid but decreases toward the present, whereas the reverse holds true for decrease in wavelength (curve B). Curve C shows a plot of amplitude against wavelength through time illustrating that the change in geometry of the strandline profiles is, indeed, at first dominated by decrease in amplitude, but since about 3400 yr B.P., by which time the amplitude is only 5 m, rapid shrinkage in the radius of the depression is more important.

The period of 7000 years which was required to eliminate the effect of the Northern Baffin Island Ice Cap upon the uplift surface is a function of the rate of decrease in the volume of that ice cap. It should not, therefore, be confused with the "relaxation time"

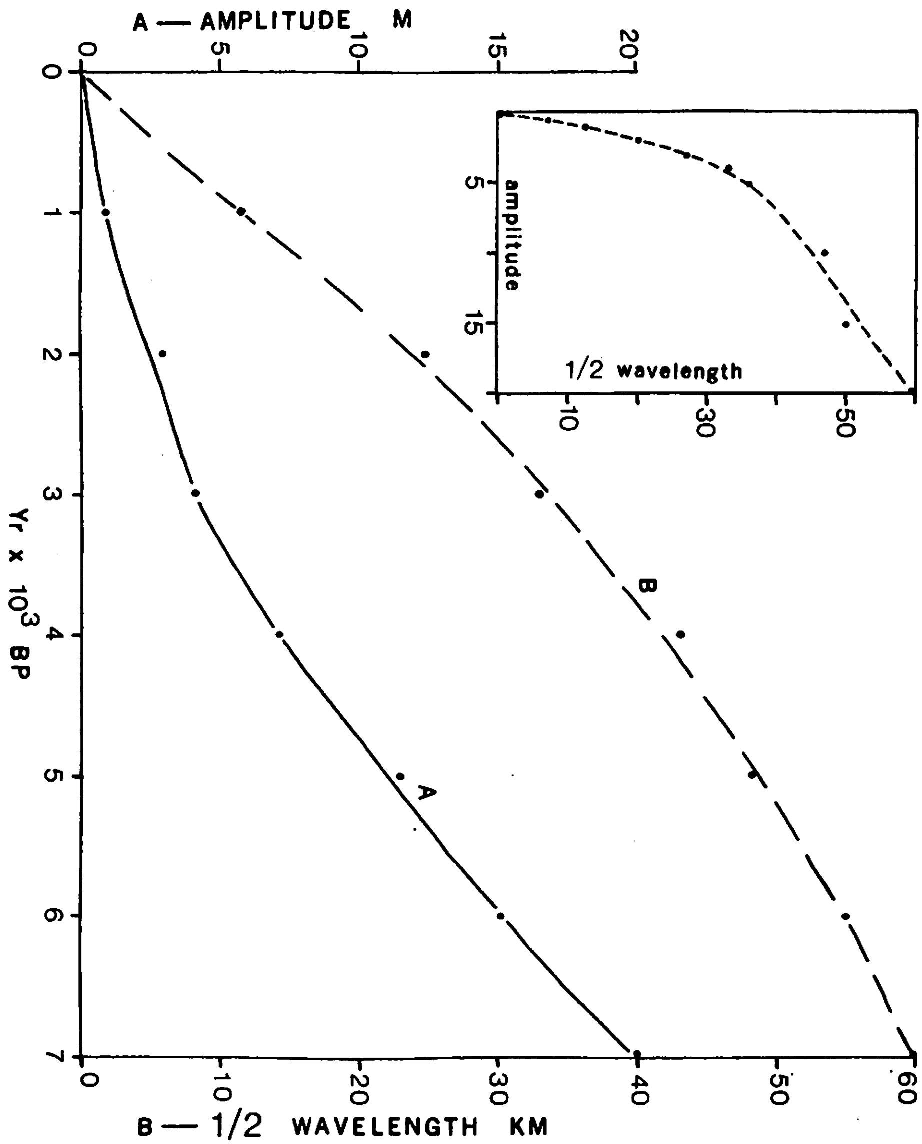

Figure 3-12: Temporal and relative changes in the amplitude and wavelength of the Baffin Island uplift dome. See the inset diagram of Figure 3-14 for the definitions of amplitude and wavelength.

of the mantle to deglaciation, which is controlled by processes operative in the upper mantle, and is a function mainly of the viscosity in the asthenosphere, rather than the rate of unloading.

POSTGLACIAL UPLIFT CURVES

Postglacial uplift curves, almost without exception, show that the rate of rebound decays exponentially as a function of time (Andrews, 1970b). Therefore, the form of the curves generated by an equidistant diagram can provide an independent check upon the accuracy with which the isobases have been placed and, thus, upon the geometry of deformation as interpreted from the field data.

Figure 3-13 contains a series of six uplift curves (semi-log plots) constructed from Fig. 3-11b. The curves show amounts of rebound that have occurred since 8000 yr B.P. for Home Bay and five other points spaced at 60 km intervals along the profile of the equidistant diagram. In all cases the data read from the diagram fall along approximately exponential curves. This is interpreted as an indication of the general accuracy of the isobase maps and the reliability of the elevation measurements, stratigraphic interpretations and radiocarbon age determinations.

The curves, however, depart slightly from a simple exponential function in that they systematically show a slower rate of rebound between 8000 yr and 6000 yr B.P. than is predicted by such a function. This may be accounted for either by: (1) a systematic error in the isobase maps such that uplift is under-estimated on the 8000 yr and 7000 yr B.P. surfaces. The most likely cause of this discrepancy would be the application of too small an eustatic

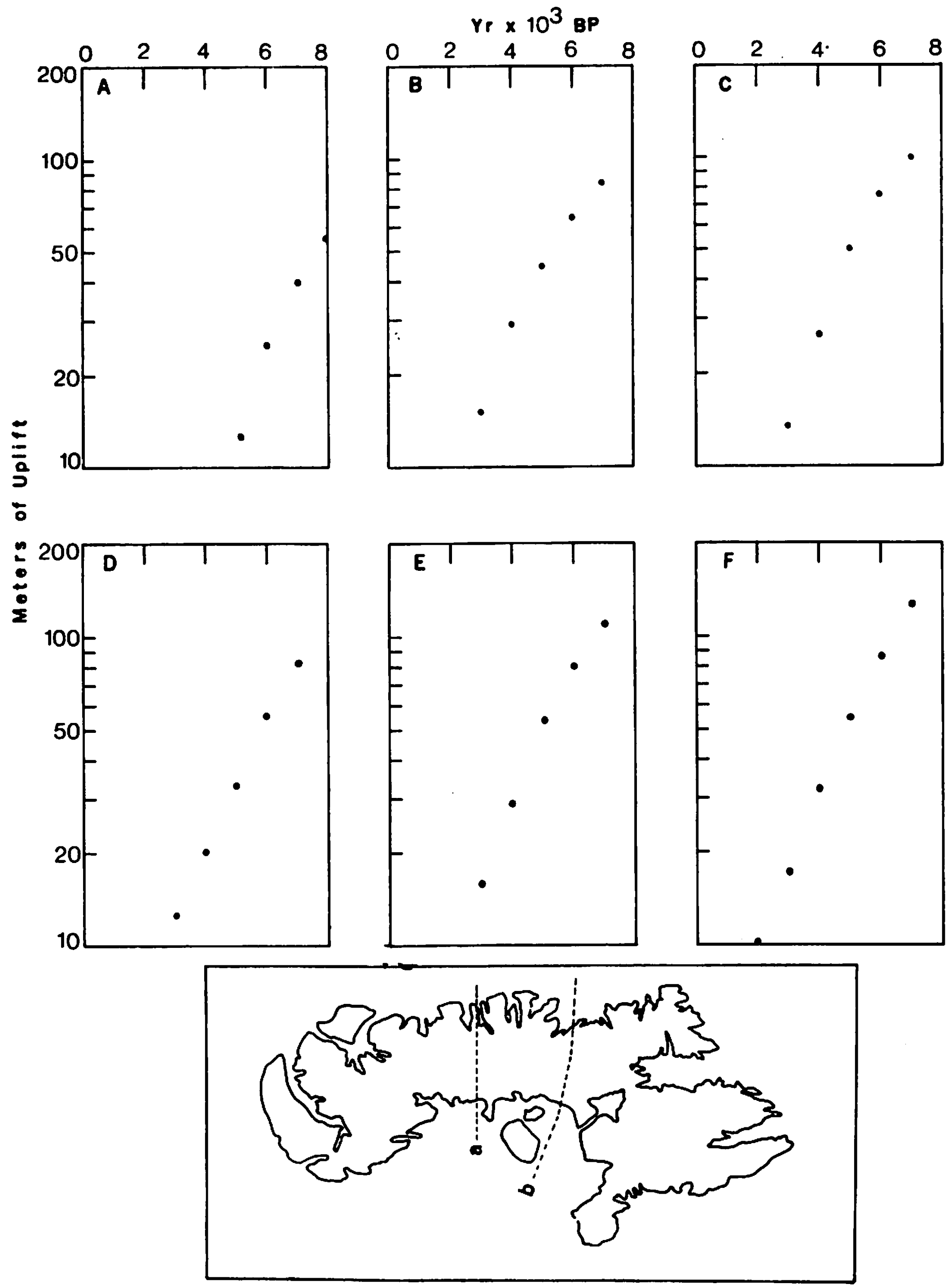

Figure 3-13: Uplift curves derived from the equidistant diagram of Figure 3-11b. Points A through F correspond to the lettered points on the equidistant diagram. The inset map shows the geographic locations of the horizontal axes of the equidistant diagrams.

correction for these times; or (2) the slower rate of rebound prior to 6000 yr B.P. may be real, constituting the restrained rebound portion of the curves (c.f. Andrews 1970b, Fig. 1-6). The more rapid rate of rebound after 6000 yr B.P. is probably a response to the deglaciation of Foxe Basin (Fig. 2-1).

By 2000 yr B.P. the zero isobase lies landward of that point represented by curve A (see insert map, Fig. 3-13). Therefore, if eustatic sea level has continued to rise during the past 2000 years, the outer peninsulas of Home Bay and much of eastern Baffin Island should presently be submerging. Field observations confirm that this is the case (Pheasant, 1971; Schlederman, 1972; Pheasant and Andrews, 1973).

AMPLITUDE OF THE BAFFIN ISLAND UPLIFT DOME AND ICE CAP PARAMETERS

Using the results presented in Table 2-I and equation 2-4, Fig. 3-14 was prepared to illustrate the change in amplitude of the Baffin Island uplift dome as a function of: (a) thickness of ice above the crests of the hypothetical strandlines (curve A), (b) thickness of ice at the center of the ice cap (curve B), and (c) total estimated volume of the ice cap (curves C and C'). The amplitude of the dome was measured from the equidistant diagram (Fig. 3-11a) as the difference in height between the crest of a strandline and the base of the corresponding westward trough (inset, Fig. 3-14).

The curves show the following relationships:

(a) The amplitude decreases at a decreasing rate as the thickness of ice above the strandline crest decreases. This may be expressed as

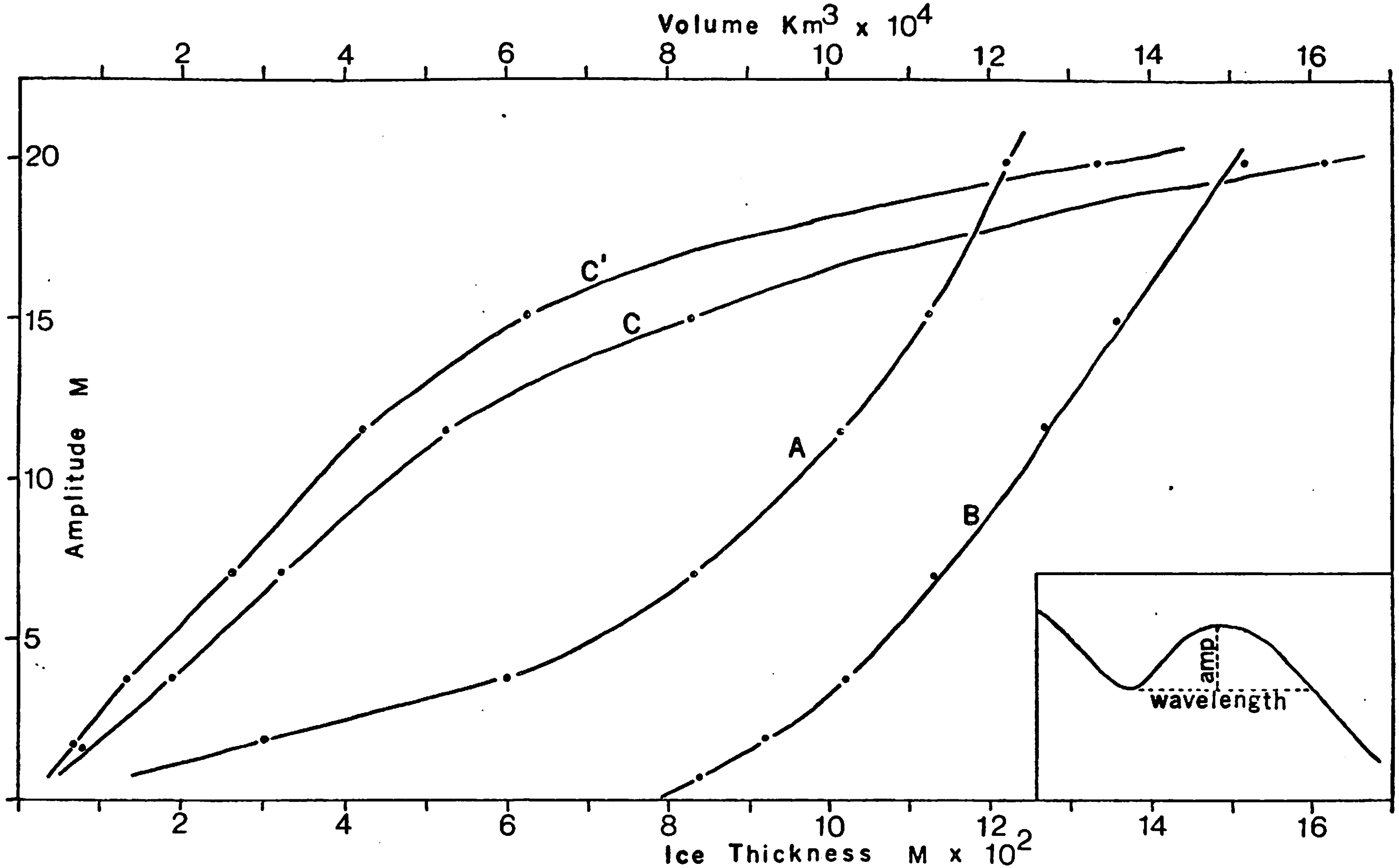

Figure 3-14: The functional relationship between the amplitude of the Baffin Island uplift dome and ice cap parameters (volume and thickness). Curve A: amplitude versus thickness of ice above the crest of the strandline; curve B: amplitude versus thickness of ice at the center of the ice cap; curve C: amplitude versus the volume of the ice cap (from equation 2-1); curve C': amplitude versus the volume of the ice cap (from equation 2-2). The insert graphically defines amplitude and wavelength.

$$A = kT_d^{\,x} \qquad (3\text{-}2)$$

where A is amplitude, T_d is ice thickness above the crest of the strandline and k and x are constants. The amplitude is about 0.5 m when ice thickness is zero. In other words, when the site became deglaciated only about 0.5 m of depression attributable to the load formerly present remained.

(b) The amplitude decreases nearly linearly as the thickness of ice at the center of the ice cap decreases. Extrapolation downward of curve B suggests that a central ice cap thickness of 750 to 800 m may be the critical lower limit on the size of the load necessarily to produce recognizable depression of the crust. This is only slightly less than the present central thickness of the Barnes Ice Cap and a value of 0.5 m seems reasonable for the equilibrium depression of that load.

(c) The amplitude decreases at a decreasing rate as the volume of the Northern Baffin Island Ice Cap decreases. The curves of volume vs. amplitude pass through or nearly through the origin when extrapolated downward, suggesting that a volume of less than 2×10^3 km^3 of ice may produce a small amount of depression or restraint of proceeding rebound.

Figure 3-15 plots volume of the Northern Baffin Island Ice Cap against the thickness of ice at its center. When the central thickness is 750 to 800 m the volume will be about 2×10^3 km^3. For thicknesses exceeding 800 m the volume increases exponentially, whereas lower thicknesses relate to very slowly decreasing volumes. This would seem to support the estimates of the lower critical values of thickness and volume which are necessary to produce

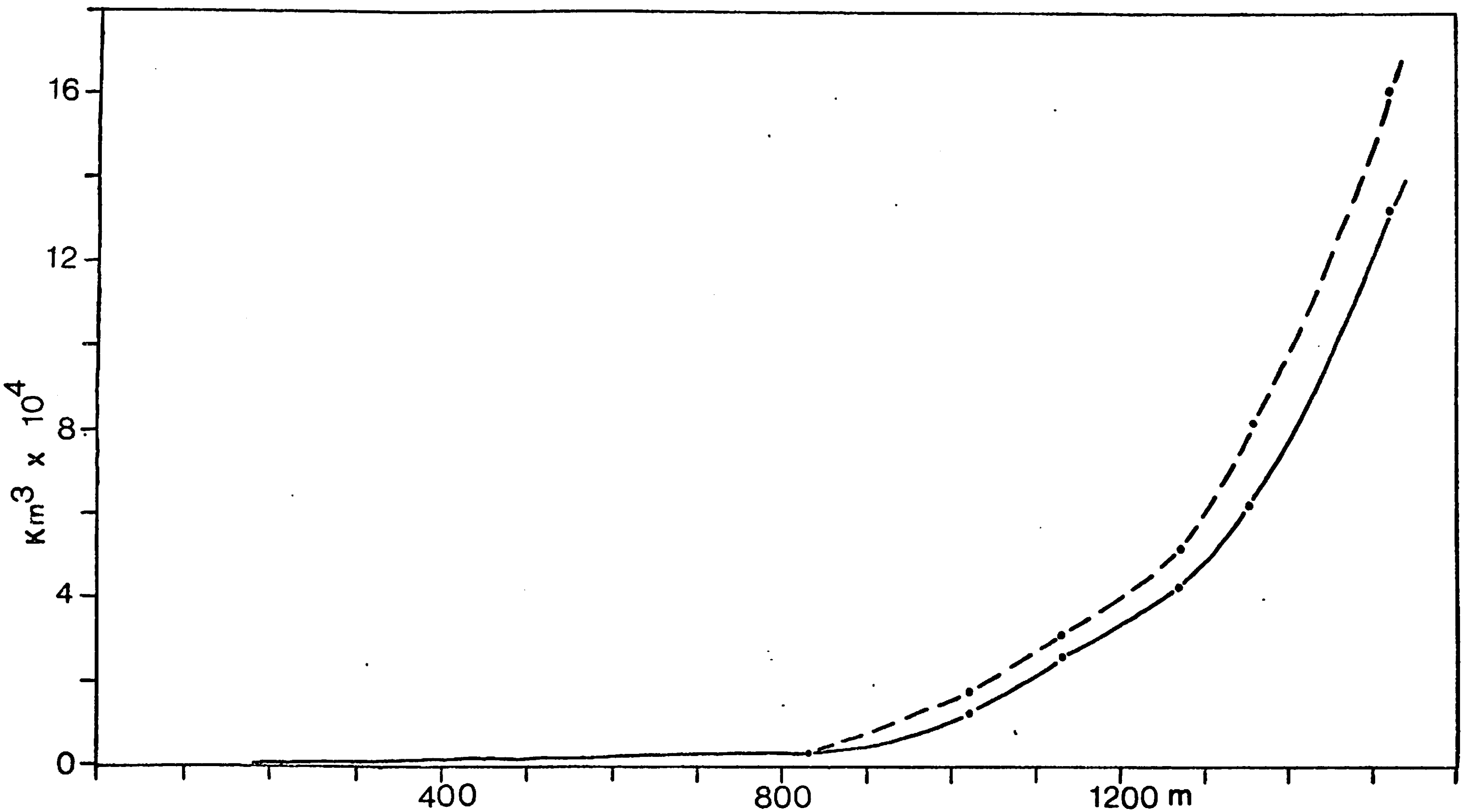

Figure 3-15: Volume of the Northern Baffin Island Ice Cap versus central ice thickness. Broken line is volume according to equation 2-1; solid line in volume according to equation 2-2.

crustal depression.

It is unlikely that depressions of smaller amplitudes and wavelengths than those discussed here can be recognized from age and elevation determinations on postglacial strandlines. Such recognition may be possible when accurate data becomes available through precise levelling and relevelling or when purely glacio-isostatic anomalies have been separated from gravimetric data and mapped on large scales.

Barnett (1967) attempted to measure (by levelling) the gradient of the Generator Lake shoreline* which has an age of about 3000 yr. He found that the western end of his traverse was only 22.5 cm higher than the eastern end but concluded that this difference may lie within the error range of the survey method. From Fig. 3-11a one would predict an elevational difference of about 1.0 m over this 20 km distance. However, the great difficulty of identifying in the field exactly synchronous points on a strandline makes it nearly impossible to determine the exact magnitude of such a low gradient. Barnett's field results cannot, therefore, be conclusively interpreted as either enforcing or weakening the validity of the construction of the 3000 yr B.P. strandline on Fig. 3-11a. It is, however, encouraging that the results may at least indicate a slight westward increase in the elevation of the strandline.

Ives (1962) determined that the Isortog Lake shorelines which are dated between 200 yr and 350 yr B.P. are not measurably tilted.

-----

*A strandline formed around a lake dammed by the retreating Northern Baffin Island Ice Cap and located near the present southeastern margin of the Barnes Ice Cap.

This lack of tilting is very probably real as Fig. 3-11a shows that the northern Baffin Island uplift dome has a negligible amplitude since 1000 yr B.P.

Figure 3-16 shows the total uplift that has occurred at a point (X) on the profile of Fig. 3-11a. Curve A is the standard time-elevation curve portraying the roughly exponential decay in the rate of uplift. (Note, however, that this curve shows the same departure from a simple exponential function as those discussed above.) Curve B is a plot of the total amount of uplift achieved since the disappearence of calculated ice thicknesses (based on equation 2-4) from directly above the point. For an area that has experienced unrestrained (true postglacial) rebound for only the past 500 years, this is a more physically meaningful relationship. The points plot with only small scatter from a straight line on semi-log paper and may, therefore, be described by equation 3-2. The scatter of points about the line is probably due mainly to errors in the estimation of ice thicknesses resulting from slight errors in the isochrone map.

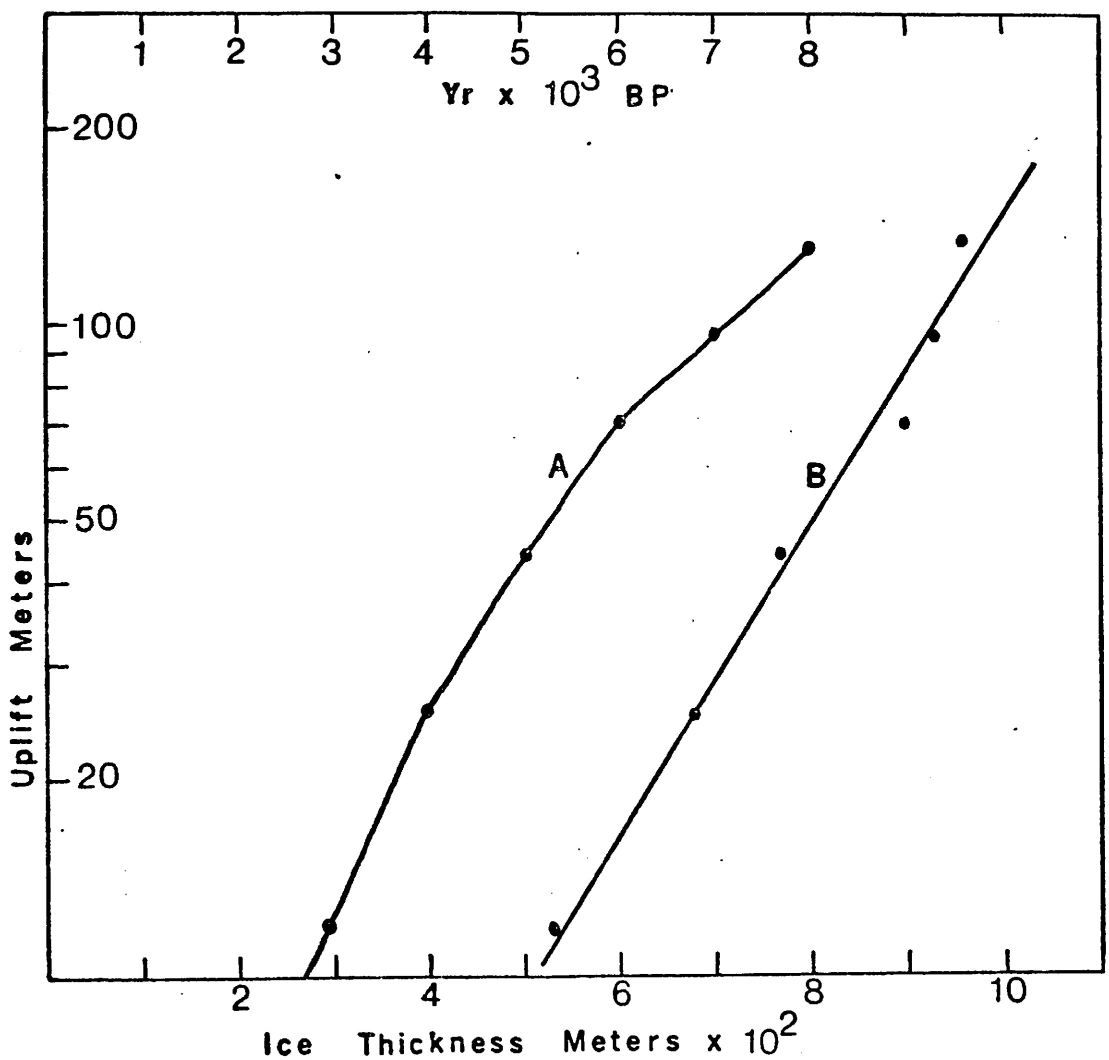

Figure 3-16: Curve A: Uplift as a function of time
Curve B: Uplift as a function of the rate of unloading...i.e. Uplift occurring since the removal of calculated ice thickness from immediately above the point represented by the curves (see point X on Figure 3-11a).

RESIDUAL REBOUND

Unlike postglacial rebound, residual (remaining) rebound cannot be measured and can be at best only predicted. There is not at present a consensus concerning the correct (or best) method of prediction of this quantity. Estimates of the amount of residual rebound on Southampton Island, for instance, vary from 110 m (Andrews, 1970b) to 140 m (Walcott, 1970). The former estimate is based on the rate of postglacial rebound, while the latter is based on the magnitude of Free Air gravity anomalies, which through a process of smoothing supposedly correlate closely with the amount of mass deficiency in the mantle due to the former ice load. Estimates by these authors are more divergent still for other areas of Hudson Bay.

Here an attempt is made to predict the amount of residual rebound for Southampton Island from the measured apparent "migration" of isobases during postglacial time toward the uplift center over that area and the graphic extrapolation of this migration into the future. The basic assumption of this method is that when the zero isobase reaches the center, rebound will be complete (the lithosphere will be in a state of isostatic equilibrium).

Figure 3-17 presents plots of isobase positions through time relative to the Southampton Island uplift center for three radii (see inset map Fig. 3-18). The lines, therefore, are plots of isobase migration. The last "known" position of any isobase is that portrayed on the map of uplift accomplished since 1000 yr B.P. (Fig. 3-10). Thereafter, isobase positions are speculatively placed by extrapolation of the migration line trends.

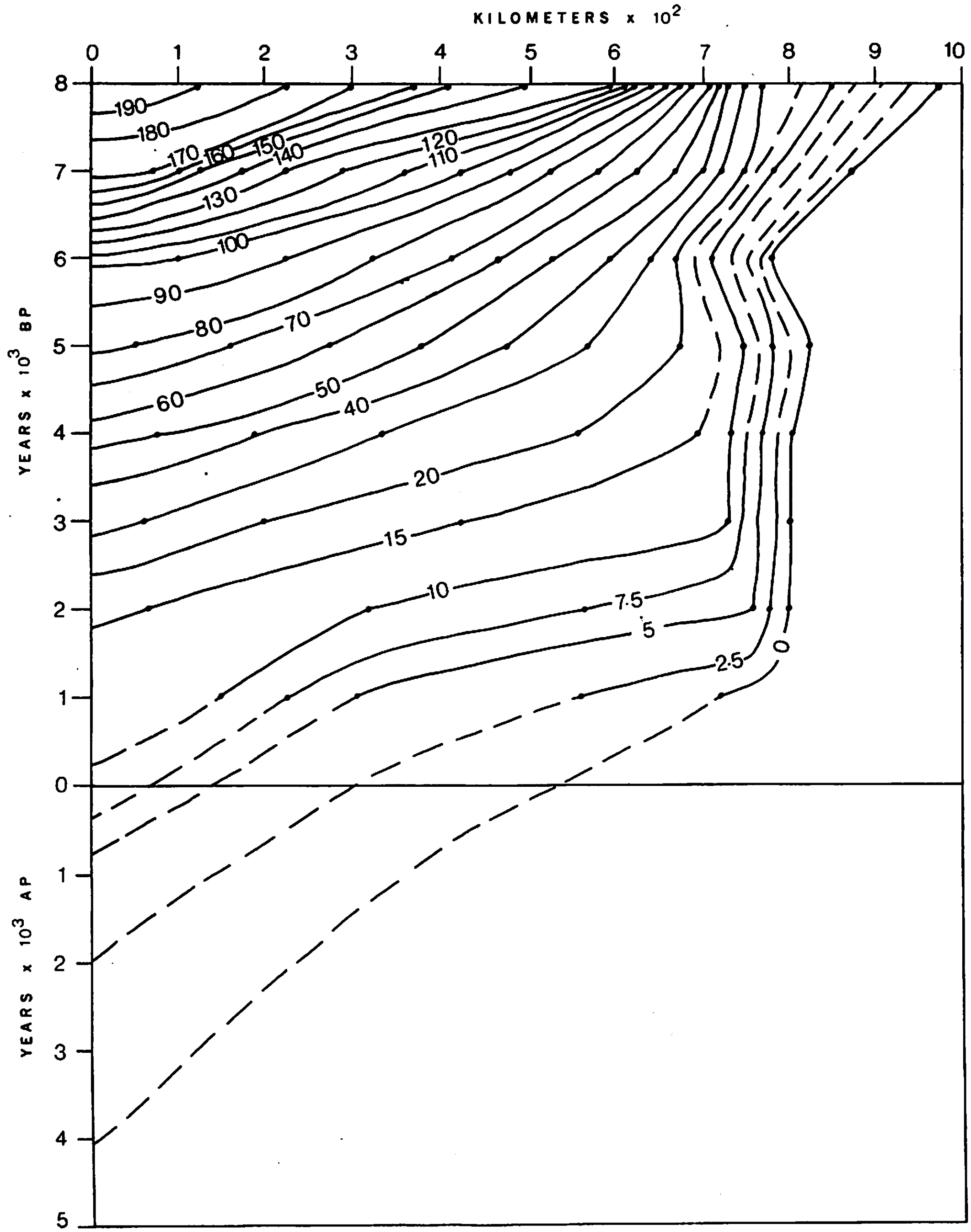

Figure 3-17a: Measured and extrapolated positions of isobases through time along a profile from Southampton Island to the mouth of Frobisher Bay (Profile A, inset map, Figure 3-18).

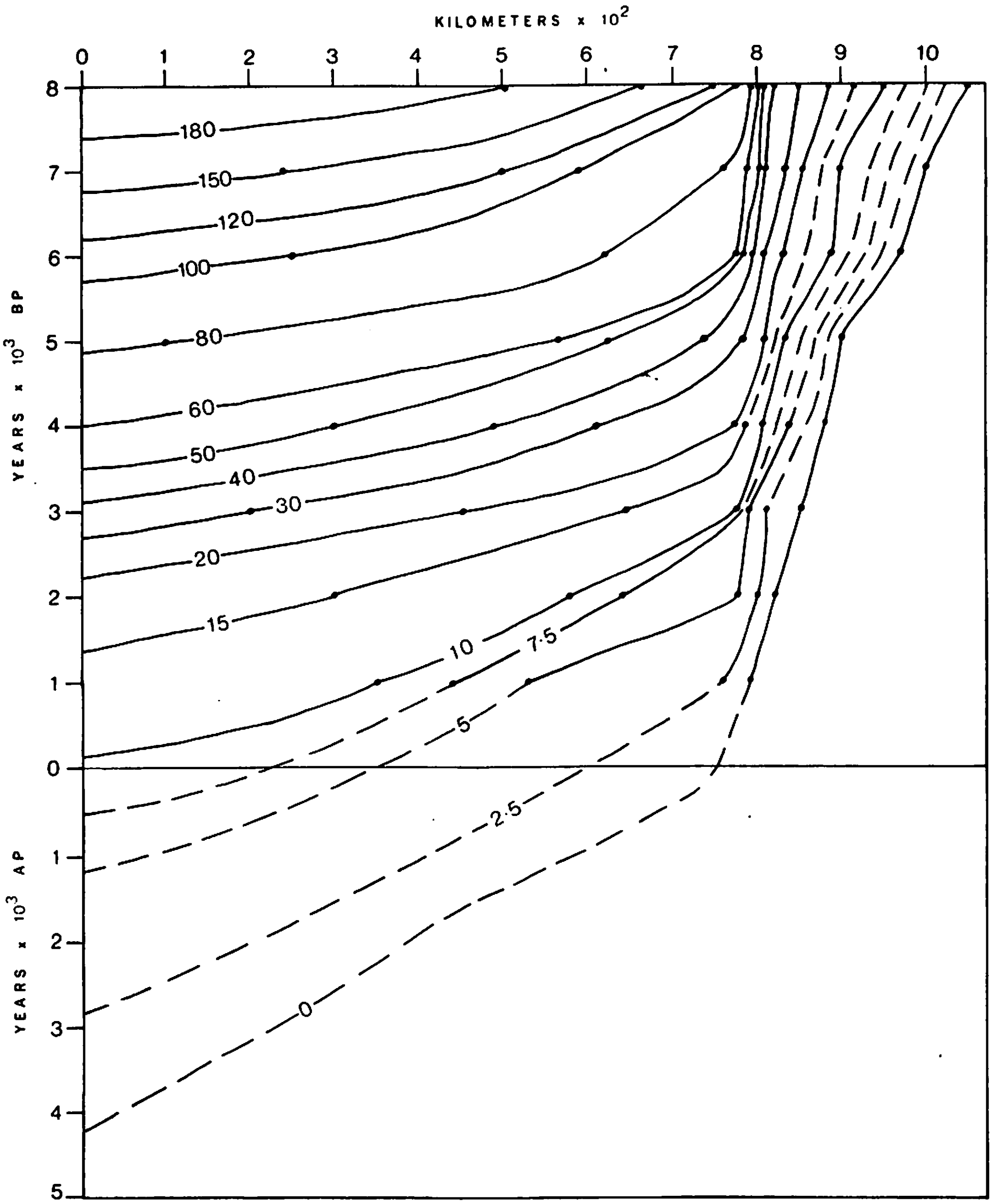

Figure 3-17b: Measured and extrapolated positions of isobases through time along a profile from Southampton Island northeastward across the Barnes Ice Cap (Profile B, inset map, Figure 3-18).

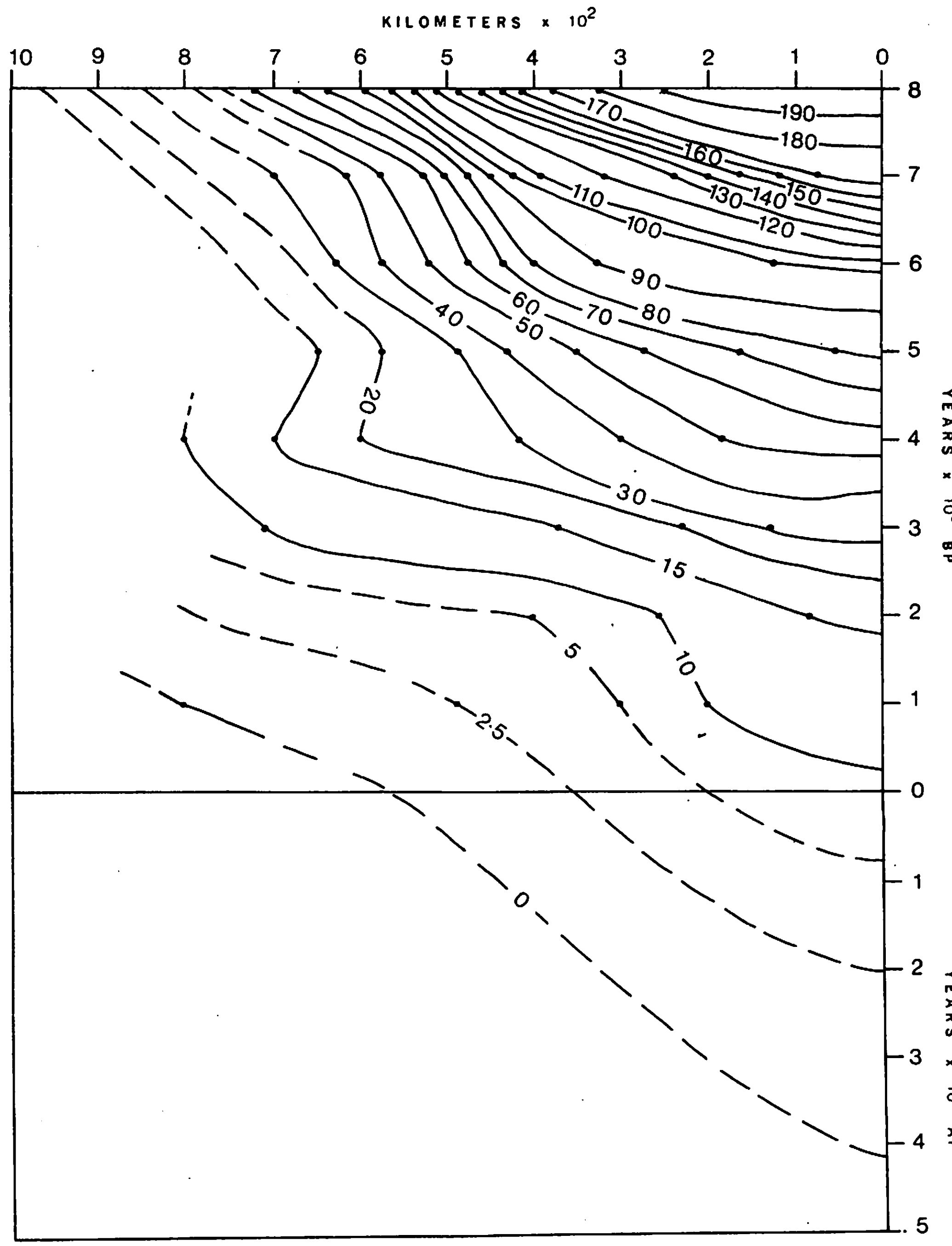

Figure 3-17c: Measured and extrapolated positions of isobases through time along a profile from Southampton Island to King William Island (Profile C, inset map, Figure 3-18).

The extrapolations, if reasonable, suggest that the zero isobase will have migrated to the center, and, therefore, that uplift will be complete in approximately 4000 years from the present. Since 1000 yr B.P. approximately 12 m of uplift have been accomplished at the center. Even if the rate of rebound continues undiminished, the amount of residual rebound of Southampton Island will be only about 48 m.

In the discussion above of the change in geometry of the Baffin Island uplift dome it was shown that this change was at first dominated by decrease in amplitude and later by rapid shrinkage of areal extent. The plots of Fig. 3-17 suggest that the same sequence of events characterizes larger uplift units.

Using the curves of Fig. 3-17, a plot was made of (a) the distance of an isobase from the center of uplift, vs. (b) the length of time required for that isobase to migrate to the center (Fig. 3-18). The three curves are similar, approximately exponential forms, and the difference between them may be attributed to the non-circular form of the Southampton Island uplift dome. It would seem likely that Fig. 3-18 may also be interpreted as a plot of (a) the radius of a depressed region, vs. (b) the time required to complete recovery of that depression. If so the recovery time increases exponentially as the radius of the depressed region increases. The relationship shown by this graph may not necessarily apply strictly to other regions which may have different crustal and/or mantle properties.

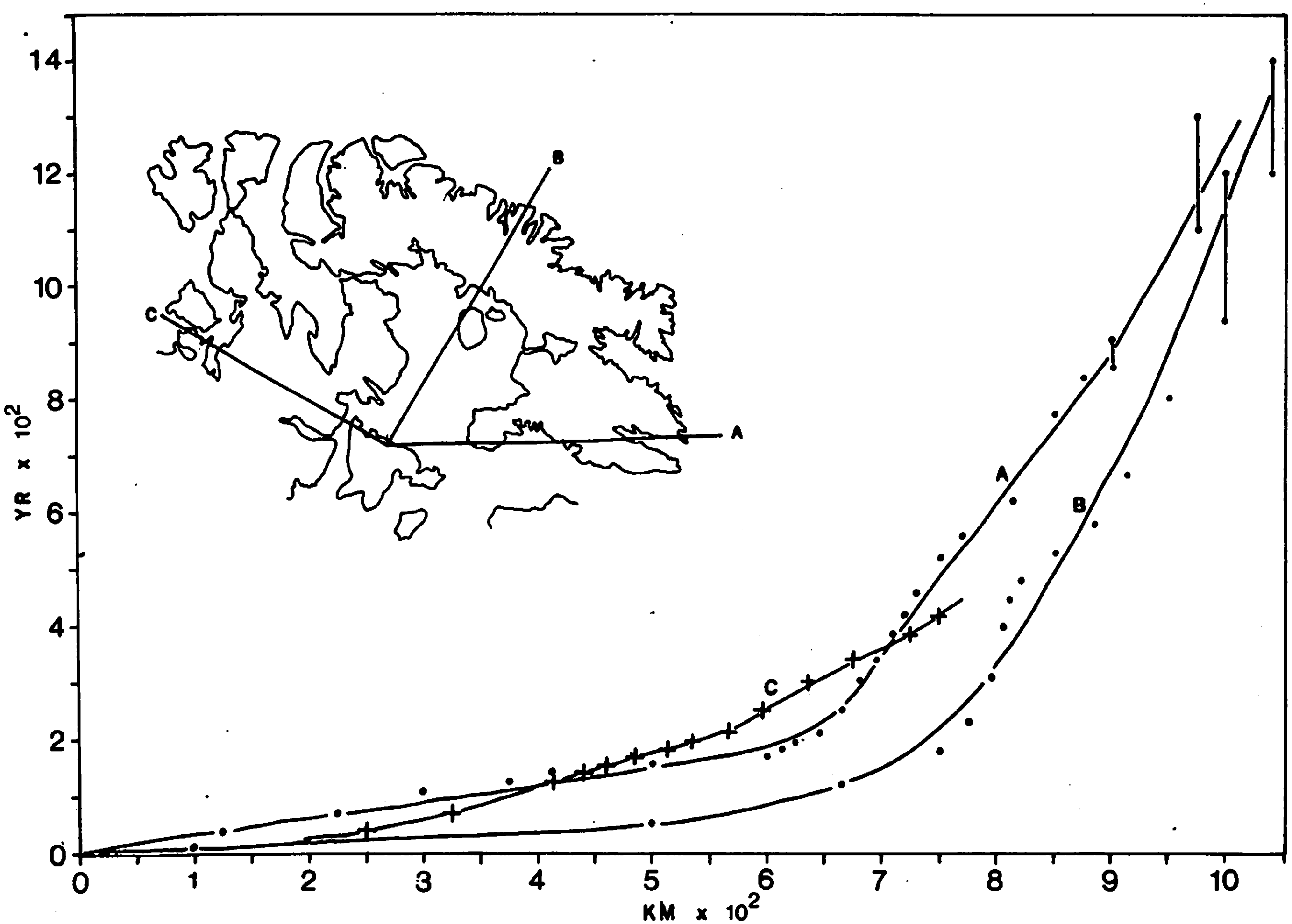

Figure 3-18: Distance of an isobase from the regional center of uplift versus the time required for that isobase to migrate to the center. Data is from Figures 3-17a, b, and c.

CHAPTER 4

CONCLUSIONS AND IMPLICATIONS

Detailed conclusions were presented in the preceding chapters. The following list reiterates the major points of the discussion in a more generalized manner. Following the outline of the conclusions, implications of the results for geomorphologists and geophysicists are discussed.

CONCLUSIONS

1) There is little information on the pattern and chronology of growth of the northeastern sector of the Laurentide Ice Sheet. A good working hypothesis has been proposed by Ives and Andrews (1963) which is supported by the findings of Terrasmae et al. (1966). Accurate absolute age determinations on the Isortoq plant beds and on shells transported from Foxe Basin and deposited in till over western Baffin Island would provide very useful dating control on the initiation and maximum of this sector of the ice sheet. Shells transported from Hudson Strait and deposited in till on southern Baffin could provide equally useful dates. Ives (personal communication, 1974) reports the discovery by Løken of shelly limestone tills in extreme northern Labrador.

2) Late Wisconsin ice over eastern and northern Baffin Island remained at its maximum until approximately 8000 yr B.P. The maximum stand was along the Cockburn Moraines or the time-stratigraphic equivalents of these moraines.

3) The retreat of ice over Baffin Island is described with reasonable accuracy by Fig. 2-1 although future field research will undoubtedly necessitate significant revisions. The isochrone map has been used to produce reasonable estimates of temporal change in ice area, volume and thickness.

4) The 8000 yr B.P. isobase surface reflects with considerable detail the late Wisconsin maximum ice stand. Depression due to the ice load extended about 200 km beyond the margin, while deflection at the margin was about 90 m.

5) The pattern of isobases on the 7000 yr B.P. surface is significantly different from that on the 8000 yr B.P. surface. By 7000 yr B.P. the Laurentide Ice Sheet had fragmented into several major bodies. This pattern of decay is reflected in the isobase surfaces for 7000 yr to 1000 yr B.P.

6) The Northern Baffin Island Ice Cap, due to its considerable size and slow rate of retreat, produced a restraining effect upon the isostatic recovery of central Baffin Island. The maximum dimensions of the central Baffin uplift were 20 m amplitude by 65 km transverse radius by 650 km longitudinal radius. The decrease of these dimensions was controlled by the rate of decrease of the ice load.

7) From the combination of isochrone and isobase maps it is possible to produce uplift curves showing the functional relationship between amounts of uplift and rates of unloading. This information is probably more physically meaningful than traditional curves showing uplift with time.

8) Isobase positions are continuously displaced toward the regional uplift centers as the crust recovers from the depression of former ice loads. The pattern of this "isobase migration" during the postglacial provides a basis for extrapolation of the future migration of the zero isobase. On the basis of such extrapolation the zero isobase is expected to reach the center of uplift on Southampton Island in about 4000 yr time. Because the future rate of uplift is unlikely to exceed the average rate for the past 1000 years (ca. 1.2 m 100 yr^{-1}), the amount of residual rebound at the center is at most 48 m.

IMPLICATIONS

A) Geomorphological implications

1) Due to the inherent strength (rigidity) of the lithosphere, an ice sheet will depress the crust for a considerable distance beyond its own margin. In the zone of peripheral depression marine strandlines may form which become elevated subsequent to glacial unloading. The presence of a raised marine feature does not, therefore, necessarily mean that the subjacent area was glacierized immediately prior to the formation of that feature. Likewise, the common practice of using the marine limit age as being synonymous with the date of deglaciation should be applied with a great deal more care.

B) Geophysical implications

1) Small wavelength disturbances on the overall deformation surface produced by an ice sheet can be caused by regional ice bodies during deglaciation. These perturbations have completely

relaxed by now.

2) The crustal flexural parameter can be calculated as follows:

$$\alpha = D\,(1.108)^{-1} \text{ (Walcott, 1970)} \quad , \qquad (4\text{-}1)$$

where α is the flexural parameter and D is the distance from the ice edge to the proximal side of the forebulge. The proximal side of the forebulge is defined by the zero isobase. D on eastern Baffin Island is approximately 200 km. Therefore, the flexural parameter in the eastern Baffin Island area is ca 180 km. This is in agreement with the value computed by Walcott for the Caribou Mountains area of Alberta. In that area the minimum value of the flexural parameter lies between 110 and 140 km. Pheasant and Andrews (1973) derived an estimated value of $\gtrsim$ 135 km for northern Cumberland Peninsula.

3) If the predicted migration of the zero isobase is reasonable, uplift will be complete at the Southampton Island uplift center within 4000 years. This precludes a lengthy relaxation time for glacio-isostatic recovery (cf. Walcott, 1970, p. 5).

C) Implications for geophysical modelling and future field research

1) Attempts to construct geophysical models of glacio-isostatic recovery generally proceed on the assumption that the ice sheet had produced an equilibrium depression prior to the onset of general retreat. To test this assumption it is necessary to firmly establish the pattern and chronology of ice sheet growth (see conclusion 1 above).

2) Because smaller wavelength depressions may have been produced by residual ice caps centered over regional retreat areas, it is important that geophysical models should predict these depressions as well as the general depression field produced by the ice sheet at its maximum. Field work leading to the production of detailed, large scale isochrone and isobase maps of these retreat areas is an essential companion to such modelling.

The Glacial Map of Canada shows that with only minor breaks the periphery of the Labrador-Ungava Peninsula is covered with postglacial marine and lacustrine sediments, and that these sediments extend well inland from the coast in many regions. Careful studies of the deformation of strandlines in these areas should provide the information needed for a detailed analysis of the interaction between changing ice loads and crustal response. Equally good opportunities for extension and refinement of data exist in Keewatin.

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APPENDIX A

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ID: RADIOCARBON DATA BANK THESIS QUERY 3 A. DYKE

READ DATA BANK

STORED ON TAPE 03/10/73
THE SIZE OF THE DATA BANK IS MEASURED BY THE FOLLOWING
CRITICAL VALUES.
NO. OF DESCRIPTORS [NODESC] = 16
NO. OF NUMERIC DESCRIPTORS [FTBI] = 7
NO. OF DESCRIPTOR DICTIONARY ENTRIES [NODDE] = 16
NO. OF DESCRIPTOR-STATE SUBDICTIONARY RESERVATIONS
[NODSSE] = 4036
NO. OF OVERFLOW ENTRIES [OVX] =  149
NO. OF STRINGS IN IFILES [NOIF] =156
NO. OF BUFFERS OF IFILES [IBUF] =  1
LENGTH OF LAST BUFFERLOAD OF IFILES [LWAIF] =18
NO. OF BITS IN LAST WORD OF LAST BUFFERLOAD [LBAIF] =24
NO. OF ITEMS = 1044

PRINT:(LATITUDE,LONGITUDE,SAMPLE NO.,LAB NO.),
(C14 DATE,STANDARD ERROR,MATERIAL DATED,INFERRED
RELIABILITY OF DATE),
(UPLIFT,ELEVATION OF SAMPLE,INFERRED RELATIVE SEA LEVEL),
(ELEVATION OF LOCAL MARINE LIMIT.
DATE ASSOCIATED WITH MARINE LIMIT),
(RELATION.TO ICE MARGIN,DISTANCE.FROM MAXIMUM ICE MARGIN,
 REFERENCE)
FOR ITEMS WITH LATITUDE. FROM 5800 TO 7600 AND LONGITUDE.
FROM 6000 TO 10000
AND C14 DATE. FROM 8250 TO 8750*
```

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NO. OF ITEMS IN QUERY RESPONSE =   27
NO. OF ITEMS IN THE DATA BANK = 1044
PERCENTAGE OF RESPONSE/TOTAL DATA BANK =  2.59

6224 6629  538  GSC 463
     8710   180   SH  DEFINITE
          62 METERS   20 METERS   38 METERS
               ---         ---
                    ICE NEARBY    ---     GSCRCVI BLAKE
6749 8825  95   GSC288
     8620   140   SH  LIKELY
          213 METERS  190 METERS  0 METERS
               215 METERS  PROBABLE
                    ICE FAR AWAY ---      GSC5 RC 1966
6756 6603  26   GSC1638
     8410   340   SH  FAIRLY SURE
          58 METERS   34 METERS   37 METERS
               43 METERS    ---
                    ICE NEARBY    ---     MILLER  UP
6757 6545  537  GAK3092
     8290   170   SH  SMALL CHANCE
          50 METERS   23 METERS   30 METERS
               30 METERS    ---
                    ICE CONTACT   ---     ---
6805 9009  307  GSC47
     8700   120   SH  POSSIBLY
          195 METERS  171 METERS  171 METERS
               190 METERS  NO
                    ICE FAR AWAY ---      GSC1  RC 1962
6812 9034  296  I-1796S
     8370   200   SH  LIKELY
          215 METERS  164 METERS  194 METERS
               194 METERS  YES
                    ICE NEARBY    ---     I-2   RC 1962

6818 9040  310  GSC40
     8450   110   SH  SMALL CHANCE
          29 METERS   8 METERS    0 METERS
               190 METERS   ---
                    ---           ---     GSC1  RC 1962
6838 6824  546  GX 0930
     8435   105   SH  FAIRLY SURE
          76 METERS   47 METERS   55 METERS
               55 METERS   YES
                    ICE CONTACT   ---     ANDREWS 1967
```

```
6857 6834   544  GSC 813
     8630    190   SH  DEFINITE
          77 METERS   40 METERS   54 METERS
               78 METERS   YES
                    ICE NEARBY   ---     ANDREWSETA1970
6857 6907   542  I  2611
     8300    135   SH  FAIRLY SURE
          82 METERS   62 METERS   0 METERS
               87 METERS   YES
                    ICE CONTACT  ---     ANDREWS 1967
6857 6907   543  Y  1830
     8430    140   SH  FAIRLY SURE
          107 METERS  70 METERS   86 METERS
               86 METERS   YES
                    ICE CONTACT  ---     ANDREWS 1967
6915 9116   297  I-215GS
     8360    170   SH  LIKELY
          214 METERS  175 METERS  194 METERS
               194 METERS  YES
                    ICE NEARBY   ---     I-2   RC 1962
6918 6810   539  I  3236
     8670    140   SH  DEFINITE
          72 METERS   48 METERS   0 METERS
               ---          YES
                    ICE CONTACT  ---     KING1969
6928 6752   547  I  3133
     8530    140   SH  DEFINITE
          48 METERS   21 METERS   26 METERS
               42 METERS   NO
                    ICE NEARBY   ---     KING1969
7156 7834   530  I  1316
     8250    750   SH  DEFINITE
          96 METERS   67 METERS   77 METERS
               77 METERS   YES
                    ICE NEARBY   ---     ANDREWS 1967
7200 7915   529  I   724
     8350    300   SH  DEFINITE
          107 METERS  75 METERS   87 METERS
               87 METERS   YES
                    ICE NEARBY   ---     ANDREWS 1967
7442 9448   643  W1220
     8550    350   SH  LIKELY
          137 METERS  114 METERS  114 METERS
               ---          PROBABLE
                    ---          ---     BLAKE CJES1970
```

```
PRINT:SAME FOR ITEMS WITH LATITUDE. FROM 5800 TO 7600
AND LONGITUDE, FROM
6000 TO 10000 AND C14 DATE, FROM 7750 TO 8250#

7459 9859  125  GSC250
     8590   140   SH  FAIRLY SURE
          132 METERS  106 METERS  109 METERS
               109 METERS  YES
                    ICE NEARBY   ---     GSC6 RC 1967
7512 9804  73   GSC191
     8520   150   SH  FAIRLY SURE
          120 METERS  98 METERS   98 METERS
               98 METERS   YES
                    ICE NEARBY   ---     GSC4 RC 1965
7538 8430  20   S410
     8370   115   SH  SMALL CHANCE
          46 METERS   25 METERS   25 METERS
               76 METERS   NO
                    ICE FAR AWAY ---     BARR ARCTIC71$
7540 8423  182  GSC991
     8270   150   BO  FAIRLY SURE
          57 METERS   38 METERS   38 METERS
               73 METERS   NO
                    ICE FAR AWAY ---     GSC9 RC 1970
7540 8427  19   GSC991
     8270   150   BO  FAIRLY SURE
          61 METERS   42 METERS   42 METERS
               76 METERS   NO
                    ICE FAR AWAY ---     BARR ARCTIC71$
7540 8435  21   Y1296
     8740   120   SH  SMALL CHANCE
          41 METERS   16 METERS   16 METERS
               76 METERS   NO
                    ---          ---     BARR ARCTIC71$
7541 8437  18   Y1295
     8250   160   SH  SMALL CHANCE
          27 METERS   8 METERS    8 METERS
               76 METERS   NO
                    ICE FAR AWAY ---     BARR ARCTIC71$
7545 9825  126  GSC377
     8440   150   SH  LIKELY
          97 METERS   76 METERS   76 METERS
               76 METERS   YES
                    ICE NEARBY   ---     GSC6 RC 1967
7547 8355  367  Y1295
     8250   160   BO  LIKELY
          27 METERS   8 METERS    8 METERS
               60 METERS   NO
                    ICE FAR AWAY ---     YALE 1X RC1969
```

```
7547 8355  368  Y1296
     8740   120   SH  LIKELY
          41 METERS   16 METERS   16 METERS
               60 METERS   NO
                    ICE FAR AWAY ---     YALE 1X RC1969

5800 9500  61   GX1063
     8010   95    SH  LIKELY
          184 METERS  67 METERS . 167 METERS
               150 METERS  YES
                    ICE CONTACT  ---     WAGNER 67   $
5948 6416  347  11322
     8190   710   SH  POSSIBLY
          34 METERS   15 METERS   METERS
               ---         PROBABLE
                    ---          ---     ANDREWS GB1967
5948 6416  536  I  1322
     8190   710   SH  FAIRLY SURE
          34 METERS   14 METERS   15 METERS
               ---          NO
                    ICE NEARBY   ---     ANDREWS67
6212 7538  149  GSC672
     7970   250   SH  FAIRLY SURE
          115 METERS  99 METERS   METERS
               104 METERS  PROBABLE
                    ICE NEARBY   ---     GSC7 RC 1968
6212 7538  5 8  GSC 672
     7970   250   SH  FAIRLY SURE
          156 METERS  99 METERS   140 METERS.
               140 METERS  YES
                    ICE CONTACT  ---     MATTHEWS67
6236 7040  513  GSC 425
     7980   220   SH  FAIRLY SURE
          127 METERS  75 METERS   110 METERS
               110 METERS  YES
                    ICE CONTACT  ---     GSCRCVI BLAKE
6253 6950  514  GSC 433
     7880   140   SH  FAIRLY SURE
          109 METERS  64 METERS   93 METERS
               93 METERS   YES
                    ICE CONTACT  ---     GSCRCVI BLAKE
6323 6825  535  GSC 462
     8230   240   SH  DEFINITE
          119 METERS  85 METERS   100 METERS
               100 METERS  YES
                    ICE CONTACT  ---     GSCRCVI BLAKE
6608 6543  516  GAK3093
     7870   150   SH  DEFINITE
          51 METERS   27 METERS   35 METERS
               35 METERS   YES
                    ICE CONTACT  ---     ---
```

```
6730 8700  67   MAP
     8200   200   GE  LIKELY
          174 METERS  0 METERS    155 METERS
               155 METERS  YES
                    ICE CONTACT  ---     GLMAPCAMADA $
6747 6538  515  GAK2566
     7950   170   SH  DEFINITE
          42 METERS   15 METERS   26 METERS
               46 METERS   NO
                    ICE NEARBY   ---     ---

6747 6538  534  GAK3090
     8230   160   SH  FAIRLY SURE
          45 METERS   15 METERS   26 METERS
               46 METERS   NO
                    ICE NEARBY   ---     ---
6805 6625  29   GAK3677
     7950   140   SH  FAIRLY SURE
          56 METERS   30 METERS   40 METERS
               40 METERS   YES
                    ICE NEARBY   ---     MEARS   UP
6805 6625  510  GAK3677
     7950   140   SH  DEFINITE
          56 METERS   30 METERS   40 METERS
               40 METERS   YES
                    ICE NEARBY   ---     ---
6805 6625  517  GAK3677
     7950   140   SH  DEFINITE
          56 METERS   30 METERS   40 METERS
               40 METERS   YES
                    ICE NEARBY   ---     ---
6826 6646  518  Y  1833
     7960   140   SH  DEFINITE
          36 METERS   16 METERS   20 METERS
               40 METERS   NO
                    ICE FAR AWAY ---     ANDREWS 1967
6829 9209  308  GSC46
     7790   100   SH  LIKELY
          95 METERS   80 METERS   60 METERS
               190 METERS  NO
                    ICE FAR AWAY ---     GSC1  RC 1962
6832 6810  519  Y  1834
     7820   140   SH  FAIRLY SURE
          69 METERS   46 METERS   54 METERS
               77 METERS   YES
                    ICE CONTACT  ---     ANDREWS 1967
6847 6837  509  ---
     7900   150   9E  DEFINITE
          78 METERS   62 METERS   62 METERS
               62 METERS   YES
                    ICE CONTACT  ---     ANDREWSE7A270
```

```
6847 6837  526  ---
     7900   150   GE  DEFINITE
          78 METERS   62 METERS   62 METERS
                62 METERS   YES
                      ---           ---      ANDREWS ET AL
6851 9040  295  I-213GS
     7880   150   SH  POSSIBLY
          105 METERS  89 METERS   89 METERS
                183 METERS  NO
                      ICE FAR AWAY ---       I-2   RC 1962
6858 6834  379  ---
     8000   200   GE  FAIRLY SURE
          54 METERS   37 METERS   37 METERS
                78 METERS   NO
                      ICE NEARBY    ---      ANDREWSETAL70

6858 6903  380  ---
     8000   200   GE  FAIRLY SURE
          71 METERS   54 METERS   54 METERS
                88 METERS   NO
                      ICE NEARBY    ---      ANDREWSETAL70
6918 6810  520  1  3213
     7970   140   SH  DEFINITE
          46 METERS   21 METERS   30 METERS
                50 METERS   NO
                      ICE NEARBY    ---      KING1969
6928 6752  533  1  3134
     8160   135   SH  DEFINITE
          43 METERS   19 METERS   25 METERS
                42 METERS   NO
                      ICE NEARBY    ---      KING1969
6930 8530  66   MAP
     8200   200   GE  LIKELY
          186 METERS  167 METERS  167 METERS
                167 METERS  YES
                      ICE CONTACT   ---      GLMAPCAMADA $
6938 7002  521  I  1673
     7970   340   SH  FAIRLY SURE
          84 METERS   34 METERS   68 METERS
                68 METERS   YES
                      ICE CONTACT   ---      ANDREWS 1967
6938 7002  522  I  1602
     7900   210   SH  FAIRLY SURE
          84 METERS   33 METERS   68 METERS
                68 METERS   YES
                      ICE CONTACT   ---      ANDREWS 1967
6951 6859  532  Y  1705
     8190   120   SH  DEFINITE
          46 METERS   22 METERS   27 METERS
                27 METERS   YES
                      ICE FAR AWAY ---       ANDREWS 1967
```

6952 7028 523 I 1932
7940 130 SH DEFINITE
67 METERS 51 METERS 51 METERS
61 METERS YES
ICE CONTACT --- ANDREWS 1967
7002 6834 524 I 2831
7750 135 SH DEFINITE
27 METERS 7 METERS 12 METERS
22 METERS NO
ICE FAR AWAY --- LOKEMUNPUFL
7012 7120 540 GSC 630
8000 120 SH DEFINITE
70 METERS 53 METERS 0 METERS
--- YES
ICE CONTACT --- ANDREWS 1967
7020 7108 541 I 1933
8210 130 SH DEFINITE
38 METERS 19 METERS 0 METERS
--- YES
ICE CONTACT --- ANDREWS 1967

7117 7415 526 GSC1060
8090 140 SH FAIRLY SURE
108 METERS 77 METERS 90 METERS
90 METERS YES
ICE NEARBY --- GSC RC 1971
7121 7253 531 I 1983
8180 130 SH DEFINITE
58 METERS 39 METERS 39 METERS
60 METERS NO
ICE FAR AWAY --- ANDREWS 1967
7127 7508 527 GSC1064
7890 160 SH DEFINITE
90 METERS 74 METERS 74 METERS
74 METERS YES
ICE CONTACT --- GSC RC 1971
7156 7834 530 I 1316
8250 750 SH DEFINITE
96 METERS 57 METERS 77 METERS
77 METERS YES
ICE NEARBY --- ANDREWS 1967
7203 8110 525 I 1246
7930 300 SH FAIRLY SURE
77 METERS 61 METERS 61 METERS
61 METERS YES
ICE CONTACT --- ANDREWS 1967
7258 9503 120 GSC616
7750 140 SH FAIRLY SURE
61 METERS 46 METERS 46 METERS
--- NO
--- --- GSC6 RC 1967

```
7538 8426  17   S434
     8200   140   SH  POSSIBLY
          49 METERS   30 METERS   30 METERS
               76 METERS   NO
                    ICE FAR AWAY ---     BARR ARCTIC71$
7541 8437  18   Y1295
     8250   160   SH  SMALL CHANCE
          27 METERS   8 METERS    8 METERS
               76 METERS   NO
                    ICE FAR AWAY ---     BARR ARCTIC71$
7547 8355  367  Y1295
     8250   160   BO  LIKELY
          27 METERS   8 METERS    8 METERS
               60 METERS   NO
                    ICE FAR AWAY ---     YALE 1X RC1969
7557 9752  158  GSC726
     8090   150   SH  SMALL CHANCE
          97 METERS   79 METERS   79 METERS
               95 METERS   NO
                    ---          ---     GSC7 RC 1968
```

```
PRINT:SAME FOR ITEMS WITH LATITUDE, FROM 5800 TO 7600
AND LONGITUDE, FROM
6000 TO 10000 AND C14 DATE, FROM 7250 TO 7750*

NO. OF ITEMS IN QUERY RESPONSE =   25
NO. OF ITEMS IN THE DATA BANK = 1044
PERCENTAGE OF RESPONSE/TOTAL DATA BANK =  2.39

5811 9503  622  GSC92
     7270   120   SH  FAIRLY SURE
          153 METERS  142 METERS  142 METERS
               145 METERS  ---
                    ICE NEARBY   ---     GSC3 RC 1964
5950 8000  148  GSC706
     7430   180   SH  POSSIBLY
          168 METERS  139 METERS  156 METERS
               156 METERS  YES
                    ICE NEARBY   ---     GSC7 RC 1968
5950 8000  220  GSC 706
     7430   180   SH  DEFINITE
          167 METERS  139 METERS  155 METERS
               155 METERS  YES
                    ICE CONTACT  ---     ANDREWS67
5950 8000  353  GSC706
     7430   180   SH  FAIRLY SURE
          151 METERS  139 METERS  0 METERS
               155 METERS  YES
                    ICE NEARBY   ---     ANDREWS GB1967
```

```
6214 7542  346  I729
     7650   250   SH  LIKELY
          125 METERS  111 METERS  [illegible] METERS
               144 METERS  PROBABLE
                    ICE NEARBY    ---     ANDREWS GB1967
6214 7542  595  I    729
     7650   250   SH  FAIRLY SURE
          158 METERS  111 METERS  144 METERS
               144 METERS  YES
                    ICE CONTACT   ---     ANDREWS67
6233 7723  98   GSC327
     7350   150   SH  LIKELY
          122 METERS  110 METERS  110 METERS
               110 METERS  YES
                    ICE FAR AWAY ---     GSC5 RC 1966
6233 7723  593  GSC 327
     7350   150   SH  FAIRLY SURE
          131 METERS  110 METERS  119 METERS
               140 METERS  NO
                    ICE NEARBY    ---     MATTHEWS67
6253 6951  498  GSC 504
     7490   160   SH  FAIRLY SURE
          54 METERS   41 METERS   [illegible] METERS
               93 METERS   NO
                    ICE NEARBY    ---     GSCRCVI BLAKE
6755 6637  3[illegible]   GUK3678
     7560   130   SH  FAIRLY SURE
          67 METERS   45 METERS   54 METERS
               54 METERS   YES
                    ICE NEARBY    ---     MEARS .  UP
6755 6637  511  GAK3678
     7560   130   SH  DEFINITE
          67 METERS   40 METERS   54 METERS
               54 METERS   YES
                    ICE NEARBY    ---     ---

6843 6750  506  I  3065
     7460   130   SH  DEFINITE
          31 METERS   17 METERS   19 METERS
               55 METERS   NO
                    ICE NEARBY    ---     ANDREWS 1967
6844 6839  505  I  3063
     7560   120   SH  FAIRLY SURE
          68 METERS   48 METERS   55 METERS
               55 METERS   YES
                    ICE CONTACT   ---     ANDREWSETA1970
```

```
6847 6837  502  Y  1835
     7290   120   SH  DEFINITE
          60 METERS   47 METERS   49 METERS
               62 METERS   NO
                    ICE NEARBY   ---     ANDREWS 1967
7002 6834  524  I  2831
     7750   135   SH  DEFINITE
          27 METERS   7 METERS    12 METERS
               22 METERS   NO
                    ICE FAR AWAY ---     LOKEMUNPUHL
7008 9227  116  GSC601
     7660   150   SH  LIKELY
          41 METERS   25 METERS   27 METERS
               ---         NO
                    ---          ---     GSC6 RC 1967
7009 6855  512  GSC 556
     7740   140   SH  DEFINITE
          27 METERS   12 METERS   [illegible] METERS
               34 METERS   NO
                    ICE FAR AWAY ---     ANDREWS 1967
7013 7118  503  I  1553
     7500   200   SH  DEFINITE
          76 METERS   63 METERS   63 METERS
               63 METERS   YES
                    ICE CONTACT  ---     ANDREWS 1967
7020 8648  496  GSC 306
     7690   140   SH  DEFINITE
          111 METERS  97 METERS   97 METERS
               97 METERS   YES
                    ICE CONTACT  ---     GSCRCV CRAIG
7117 8743  497  I  1254
     7560   500   SH  DEFINITE
          100 METERS  87 METERS   87 METERS
               87 METERS   YES
                    ICE CONTACT  ---     CRAIG 1965
7258 9503  120  GSC616
     7750   140   SH  FAIRLY SURE
          61 METERS   46 METERS   46 METERS
               ---         NO
                    ---          ---     GSC6 RC 1967
7442 9459  280  GSC1193
     7380   140   BO  LIKELY
          62 METERS   50 METERS   50 METERS
               ---         NO
                    ICE FAR AWAY ---     GSC11 RC 1971
```

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7541 8437  16   Y1294
     7480   120   SH  POSSIBLY
          16 METERS   3 METERS    6 METERS
               76 METERS   NO
                    ICE FAR AWAY ---     BARR ARCTIC71$
7541 9848  647  GSC736
     7670   150   SH  POSSIBLY
          40 METERS   23 METERS   26 METERS
               ---            NO
                    ICE FAR AWAY ---     BLAKE CJES1970
7547 8355  366  Y1294
     7480   120   SH  LIKELY
          16 METERS   3 METERS    3 METERS
               60 METERS   NO
                    ICE FAR AWAY ---     YALE 1X RC1969


PRINT:SAME FOR ITEMS WITH LATITUDE. FROM 5800 TO 7600
AND LONGITUDE. FROM 6000 TO 10000 AND C14 DATE.
FROM 6750 TO 7250*
NO. OF ITEMS IN QUERY RESPONSE =   48
NO. OF ITEMS IN THE DATA BANK = 1044
PERCENTAGE OF RESPONSE/TOTAL DATA BANK =  4.60

5950 8000  147  GSC688
     6940   140   SH  POSSIBLY
          157 METERS  148 METERS  148 METERS
               156 METERS  NO
                    ---            ---       GSC7 RC 1968
5950 8000  352  GSC688
     6940   140   SH  LIKELY
          157 METERS  148 METERS  . METERS
               155 METERS  YES
                    ICE NEARBY     ---       ANDREWS GB1967
6202 7432  362  NPL82
     6760   140   SH  LIKELY
          54 METERS   45 METERS   . METERS
               45 METERS   YES
                    ---            ---       NPL 1V RC1966
6207 7438  365  NPL85
     6970   125   SH  LIKELY
          100 METERS  90 METERS   90 METERS
               ---            PROBABLE
                    ICE NEARBY     ---       NPL 1V RC1966
6210 9541  247  1(GSC 8
     6975   250   SH  FAIRLY SURE
          181 METERS  64 METERS   171 METERS
               171 METERS  YES
                    ICE CONTACT    ---       LEE59
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```
6210 9541  283  I[GSC]8
     6975   250   SH  POSSIBLY
          74 METERS   64 METERS   ( METERS
               171 METERS  PROBABLE
                    ---            ---      I-1   RC 1961
6215 8000  60   GX1070
     7115   100   SH  LIKELY
          111 METERS  91 METERS   101 METERS
               ---           NO
                    ICE FAR AWAY ---     WAGNER 67   $

6216 7602  578  L   765
     7160.  195   SH  FAIRLY SURE
          130 METERS  113 METERS  119 METERS
               140 METERS  NO
                    ICE NEARBY    ---     MATTHEWS67
6227 7636  345  I726
     7160   195   SH  LIKELY
          122 METERS  111 METERS  111 METERS
             - 136 METERS  NO
                    ICE FAR AWAY ---     ANDREWS GB1967
6227 7636  596  I   726
     7160   195   SH  FAIRLY SURE
          122 METERS  111 METERS  [illegible] METERS
               136 METERS  YES
                    ICE NEARBY    ---     ANDREWS67
6232 7725  99   NPL58
     6900   130   SH  FAIRLY SURE
          92 METERS   83 METERS   83 METERS
               110 METERS  NO
                    ICE FAR AWAY ---     NPL3 RC 1966
6232 7725  360  NPL58
     6900   130   SH  LIKELY
          120 METERS  81 METERS   111 METERS
               111 METERS  YES
                    ICE NEARBY    ---     NPL111 RC 1965
6325 7643  119  GSC560
     6920   150   SH  SMALL CHANCE
          52 METERS   43 METERS   43 METERS
               150 METERS  NO
                    ---            ---     GSC6 RC 1967
6325 7643  488  GSC 560
     6920   150   SH  LIKELY
          52 METERS   43 METERS   [illegible] METERS
               134 METERS  NO
                    ICE NEARBY    ---     GSCRCVI BLAKE
```

6333 8500 81 GSC311
6950 130 SH FAIRLY SURE
136 METERS 127 METERS 127 METERS
127 METERS YES
ICE NEARBY --- GSC4 RC 1965
6333 8500 224 I 2443
6950 130 SH FAIRLY SURE
136 METERS 127 METERS 0 METERS
172 METERS YES
ICE CONTACT --- ANDREWS67 BIRD
6333 8500 357 I2443
6950 130 SH LIKELY
136 METERS 127 METERS 127 METERS
172 METERS NO
ICE FAR AWAY --- ANDREWS GB1967
6343 6827 489 GSC 464
6750 170 SH DEFINITE
39 METERS 15 METERS 30 METERS
30 METERS YES
ICE NEARBY --- GSCRCVI BLAKE

6350 8100 229 GX 1068
7170 90 SH FAIRLY SURE
141 METERS 58 METERS 130 METERS
130 METERS YES
ICE CONTACT --- WAGNER67 $
6417 8257 84 GSC323
6890 210 SH FAIRLY SURE
156 METERS 147 METERS 147 METERS
147 METERS YES
ICE NEARBY --- GSC4 RC 1965
6417 8257 202 GSC838
6890 210 SH LIKELY
169 METERS 145 METERS 160 METERS
160 METERS YES
ICE NEARBY --- GSC11RC 1971
6417 8257 226 GSC 838
6890 210 SH FAIRLY SURE
164 METERS 147 METERS 155 METERS
155 METERS YES
ICE CONTACT --- BIRD70
6419 8829 86 GSC289
6830 170 SH FAIRLY SURE
135 METERS 126 METERS 126 METERS
126 METERS YES
ICE NEARBY --- GSC4 RC 1965
6419 8829 94 GSC289
6830 170 SH FAIRLY SURE
135 METERS 126 METERS 126 METERS
149 METERS ---
ICE FAR AWAY --- GSC5 RC 1966

```
6443 8446  83   GSC324
     6930   150   SH  FAIRLY SURE
           125 METERS  116 METERS  116 METERS
                116 METERS  YES
                     ICE NEARBY   ---     GSC4 RC 1965
6443 8446  2?1  GSC782
     6930   150   SH  LIKELY
           139 METERS  115 METERS  130 METERS
                130 METERS  YES
                     ICE NEARBY   ---     GSC11RC 1971
6443 8446  225  GSC 782
     6930   150   SH  FAIRLY SURE
           166 METERS  116 METERS  157 METERS
                157 METERS  YES
                     ICE CONTACT  ---     BIRD70
6519 7309  473  GSC 465
     6830   150   SH  DEFINITE
           114 METERS  99 METERS   105 METERS
                105 METERS  YES
                     ICE CONTACT  ---     GSCRCVI BLAKE
6602 7136  485  GSC 466
     6760   140   SH  DEFINITE
           107 METERS  91 METERS   98 METERS
                98 METERS   YES
                     ICE CONTACT  ---     GSCRCVI BLAKE
6644 8642  87   GSC286
     6850   140   SH  FAIRLY SURE
           130 METERS  121 METERS  121 METERS
                121 METERS  YES
                     ICE NEARBY   ---     GSC4 RC 1965
6644 8642  96   GSC286
     6850   140   SH  LIKELY
           130 METERS  121 METERS  0 METERS
                142 METERS  PROBABLE
                     ICE FAR AWAY ---     GSC5 RC 1966
6747 6538  507  GAK3365
     7100   140   SH  DEFINITE
           25 METERS   14 METERS   15 METERS
                46 METERS   NO
                     ICE FAR AWAY ---     ---
6752 8210  97   GSC291
     6880   180   SH  FAIRLY SURE
           143 METERS  134 METERS  134 METERS
                147 METERS  NO
                     ICE NEARBY   ---     GSC5 RC 1966
6752 8210  487  GSC 291
     6880   180   SH  DEFINITE
           143 METERS  134 METERS  134 METERS
                134 METERS  YES
                     ICE CONTACT  ---     CRAIG1965
```

```
6842 9227  293  2-212GS
     7160   160   SH  LIKELY
          64 METERS   53 METERS   53 METERS
               183 METERS  NO
                    ICE FAR AWAY ---      I-2   RC 1962
6844 6856  467  GSC 739
     6930   150   SH  LIKELY
          61 METERS   34 METERS   52 METERS
               52 METERS   YES
                    ICE CONTACT   ---     ANDREWS 1967
6918 6810  504  I  3135
     7160   140   SH  DEFINITE
          25 METERS   7 METERS    14 METERS
               50 METERS   NO
                    ICE FAR AWAY ---      KING1969
6937 7001  499  I  1598
     7200   150   SH  DEFINITE
          56 METERS   41 METERS   45 METERS
               68 METERS   NO
                    ICE NEARBY    ---     ANDREWS 1967
6937 7001  500  I  1672
     7080   170   SH  DEFINITE
          45 METERS   35 METERS   0 METERS
               68 METERS   NO
                    ICE NEARBY    ---     ANDREWS 1967
6937 7001  501  I  1554
     7030   190   SH  DEFINITE
          56 METERS   26 METERS   46 METERS
               68 METERS   NO
                    ICE NEARBY    ---     ANDREWS 1967

7009 6856  493  GSC 599
     7000   150   SH  DEFINITE
          31 METERS   21 METERS   21 METERS
               34 METERS   NO
                    ICE FAR AWAY ---      ANDREWS 1967
7036 8608  494  GSC 307
     7120   140   SH  DEFINITE
          107 METERS  97 METERS   97 METERS
               97 METERS   YES
                    ICE CONTACT   ---     GSCRCV CRAIG
7055 8627  495  GSC 304
     7240   150   SH  DEFINITE
          104 METERS  89 METERS   93 METERS
               93 METERS   YES
                    ICE CONTACT   ---     GSCRCV CRAIG
7139 8413  480  GSC 390
     6890   150   SH  DEFINITE
          49 METERS   40 METERS   40 METERS
               67 METERS   NO
                    ICE NEARBY    ---     GSCRCV CRAIG
```

```
7247 9537  248  L 571A
     7150   350   SH  LIKELY
          46 METERS   30 METERS   35 METERS
               122 METERS  NO
                    ICE FAR AWAY ---      FARRAND62BIRDS
7247 9537  314  L571A
     7150   350   SH  POSSIBLY
          41 METERS   30 METERS   0 METERS
               ---         PROBABLE
                    ---          ---      LAMONTV11 RC61
7442 9459  644  GSC1193
     7210   140   BO  LIKELY
          61 METERS   50 METERS   50 METERS
               ---         NO
                    ICE FAR AWAY ---      BLAKE CJES1970
7538 8426  15   S428
     6900   115   PT  SMALL CHANCE
          66 METERS   57 METERS   57 METERS
               76 METERS   NO
                    ICE FAR AWAY ---      BARR ARCTIC71$


PRINT:SAME FOR ITEMS WITH LATITUDE, FROM 5800 TO 7600
AND LONGITUDE, FROM
6000 TO 10000 AND C14 DATE, FROM 6250 TO 6750#

NO. OF ITEMS IN QUERY RESPONSE =   33
NO. OF ITEMS IN THE DATA BANK = 1044
PERCENTAGE OF RESPONSE/TOTAL DATA BANK =  3.16

5950 8000  218  I  2415
     6590   125   SH  DEFINITE
          108 METERS  94 METERS   100 METERS
               155 METERS  NO
                    ICE FAR AWAY ---      ANDREWS67
5950 8000  350  I2415
     6590   125   SH  FAIRLY SURE
          106 METERS  94 METERS   100 METERS
               ---         NO
                    ---          ---      ANDREWS GB1967
6207 7438  363  NPL83
     6660   125   SN  LIKELY
          83 METERS   75 METERS   0 METERS
               ---         NO
                    ---          ---      NPL 1V RC1966
6207 7438  364  NPL84
     6660   130   SH  LIKELY
          82 METERS   74 METERS   0 METERS
               ---         NO
                    ---          ---      NPL 1V RC1966
```

6207 7438 591 NPL 84
6660 130 SH FAIRLY SURE
83 METERS 74 METERS 75 METERS
140 METERS NO
ICE FAR AWAY --- MATTHEWS67
6215 8030 58 GX1071
6335 85 SH LIKELY
83 METERS 66 METERS 76 METERS
--- NO
ICE FAR AWAY --- WAGNER 67 $
6215 8030 59 GX1069
6395 90 SH LIKELY
98 METERS 81 METERS 91 METERS
--- NO
ICE FAR AWAY --- WAGNER 67 $
6249 9448 161 GSC1016
6570 140 SH LIKELY
130 METERS 122 METERS METERS
168 METERS PROBABLE
--- --- GSC9 RC 1970
6250 7254 348 I2444
6580 125 SH LIKELY
52 METERS 44 METERS 44 METERS
--- NO
ICE FAR AWAY --- ANDREWS GB1967
6250 7254 594 I 2444
6580 125 SH FAIRLY SURE
52 METERS 44 METERS METERS
--- NO
ICE FAR AWAY --- ANDREWS67
6343 6827 489 GSC 464
6750 170 SH DEFINITE
39 METERS 15 METERS 30 METERS
30 METERS YES
ICE NEARBY --- GSCRCVI BLAKE
6345 6832 491 GSC 533
6440 160 SH SMALL CHANCE
37 METERS 4 METERS 30 METERS
30 METERS YES
ICE NEARBY --- GSCRCVI MATTH
6406 8405 82 GSC308
6535 115 SH POSSIBLY
174 METERS 166 METERS 166 METERS
166 METERS YES
ICE NEARBY --- GSC4 RC 1965

6406 8405 223 GX09986
6535 115 SH FAIRLY SURE
168 METERS 160 METERS 160 METERS
160 METERS YES
ICE CONTACT --- ANDREWS67 BIRD
6425 8530 85 GSC337
6580 125 SH FAIRLY SURE
96 METERS 88 METERS 88 METERS
88 METERS YES
ICE NEARBY --- GSC4 RC 1965
6425 8530 227 1 2963
6580 125 SH FAIRLY SURE
108 METERS 88 METERS 100 METERS
157 METERS NO
ICE NEARBY --- BIRD70
6513 8532 80 GSC309
6610 125 SH FAIRLY SURE
120 METERS 112 METERS 112 METERS
112 METERS YES
ICE NEARBY --- GSC4 RC 1965
6513 8532 222 I 2432
6610 125 SH FAIRLY SURE
120 METERS 112 METERS [illegible] METERS
145 METERS YES
ICE CONTACT --- ANDREWS67 BIRD
6513 8532 355 12432
6610 125 SH LIKELY
120 METERS 112 METERS [illegible] METERS
--- PROBABLE
ICE FAR AWAY --- ANDREWS GB1967
6519 7309 474 GSC 553
6590 140 SH DEFINITE
98 METERS 88 METERS 90 METERS
105 METERS NO
ICE NEARBY --- GSCRCVI BLAKE
6606 8405 356 GX09986
6535 114 SH POSSIBLY
174 METERS 166 METERS [illegible] METERS
166 METERS YES
ICE NEARBY --- ANDREWS GB1967
6723 6500 492 GAK3685
6350 110 SH DEFINITE
25 METERS 15 METERS 18 METERS
18 METERS YES
ICE CONTACT --- ---
6740 9827 69 GSC235
6740 150 SH LIKELY
28 METERS 18 METERS 20 METERS
--- NO
ICE FAR AWAY --- GSC4 RC 1965

```
6832 6810  481  I  2695
     6560  125   SH  DEFINITE
          42 METERS   26 METERS   34 METERS
               79 METERS   NO
                    ICE FAR AWAY ---     ANDREWS 1967
6832 6823  468  GSC 827
     6650  180   SH  FAIRLY SURE
          56 METERS   37 METERS   48 METERS
               59 METERS   NO
                    ICE NEARBY   ---     ANDREWSETA1970
6910 7528  471  I  406
     6725  250   SH  DEFINITE
          112 METERS  89 METERS   104 METERS
               104 METERS  YES
                    ICE CONTACT  ---     ANDREWS 1967
6921 7549  484  I  2410
     6270  210   SH  FAIRLY SURE
          91 METERS   75 METERS   84 METERS
               94 METERS   NO
                    ICE NEARBY   ---     ANDREWS 1967
6955 6843  476  I  2962
     6520  150   OR  DEFINITE
          19 METERS   9 METERS    11 METERS
               21 METERS   NO
                    ICE FAR AWAY ---     LOKEMUNPURL
6956 6840  475  I  1934
     6560  125   SH  DEFINITE
          19 METERS   11 METERS   , METERS
               21 METERS   NO
                    ICE FAR AWAY ---     ANDREWS 1967
7003 7129  486  GSC 633
     6270  150   SH  DEFINITE
          57 METERS   50 METERS   0 METERS
               ---         YES
                    ICE CONTACT  ---     ANDREWS 1967
7115 7458  483  GSC1094
     6330  140   SH  POSSIBLY
          39 METERS   32 METERS   32 METERS
               91 METERS   YES
                    ---          ---     GSC RC 1971
7153 8055  466  GSC 328
     6410  150   SH  DEFINITE
          61 METERS   54 METERS   54 METERS
               54 METERS   YES
                    ICE CONTACT  ---     ANDREWS 1967
7153 8055  469  GSC 328
     6410  150   SH  DEFINITE
          64 METERS   45 METERS   57 METERS
               57 METERS   YES
                    ICE CONTACT  ---     GSCRVI
```

PRINT:SAME FOR ITEMS WITH LATITUDE, FROM 5800 TO 7600 AND LONGITUDE, FROM
6000 TO 10000 AND C14 DATE, FROM 5750 TO 6250*

NO. OF ITEMS IN QUERY RESPONSE = 20
NO. OF ITEMS IN THE DATA BANK = 1044
PERCENTAGE OF RESPONSE/TOTAL DATA BANK = 1.92

```
6208 7441  152  GSC801
     6080   160   SH  FAIRLY SURE
          61 METERS   55 METERS   55 METERS
               ---           NO
                    ICE FAR AWAY ---      GSC7 RC 1968
6210 7558  590  N   285
     6070 . 140   SH  FAIRLY SURE
          36 METERS   21 METERS   30 METERS
               140 METERS  NO
                    ICE FAR AWAY ---      MATTHEWS67
6215 8325  57   GX1066
     5815   90    SH  LIKELY
          95 METERS   15 METERS   90 METERS
               ---           NO
                    ICE FAR AWAY ---      WAGNER 67   $
6343 6827  490  GSC 503
     6140   170   SH  DEFINITE
          20 METERS   14 METERS   [illegible] METERS
               30 METERS   NO
                    ICE NEARBY   ---      GSCRCVI MATTH
6346 9540  93   GSC439
     5900   130   SH  FAIRLY SURE
          81 METERS   70 METERS   76 METERS
               137 METERS  ---
                    ICE FAR AWAY ---      GSC5 RC 1966
6447 7552  470  GSC 561
     6120   140   SH  LIKELY
          82 METERS   76 METERS   [illegible] METERS
               150 METERS  NO
                    ICE NEARBY   ---      GSCRCVI
6608 9618  146  GSC693
     6140   150   SH  FAIRLY SURE
          55 METERS   49 METERS   49 METERS
               152 METERS  NO
                    ICE FAR AWAY ---      GSC7 RC 1968
6842 6921  452  I  2412
     5900   130   SH  FAIRLY SURE
          59 METERS   33 METERS   54 METERS
               54 METERS   YES
                    ICE CONTACT  ---      ANDREWS 1967
6852 6925  449  I  3062
     5840   150   SH  DEFINITE
          48 METERS   39 METERS   43 METERS
               4[illegible] METERS   YES
```

ICE CONTACT --- ANDREWSETA1970
6853 6902 465 1 3065
6190 120 SH FAIRLY SURE
36 METERS 30 METERS 6 METERS
40 METERS YES
ICE CONTACT --- ANDREWSETA1970
6857 6903 482 I 2583
6130 120 SH DEFINITE
30 METERS 16 METERS 24 METERS
87 METERS NO
ICE FAR AWAY --- ANDREWS 1967
6912 7443 582 F1
6000 200 GE FAIRLY SURE
76 METERS 70 METERS 70 METERS
70 METERS YES
ICE CONTACT --- ANDREWS70AAR
6914 7425 581 F2
5800 200 GE FAIRLY SURE
65 METERS 60 METERS 60 METERS
60 METERS YES
ICE CONTACT --- ANDREWS70AAR
6918 7537 472 I 405
6050 250 SH DEFINITE
82 METERS 73 METERS 76 METERS
104 METERS NO
ICE NEARBY --- ANDREWS 1967
6937 7001 478 I 1596
6150 170 SH DEFINITE
43 METERS 31 METERS 37 METERS
68 METERS NO
ICE FAR AWAY --- ANDREWS 1967
6950 7020 479 GSC 631
6220 140 SH DEFINITE
37 METERS 31 METERS 31 METERS
61 METERS NO
ICE NEARBY --- ANDREWS 1967
7000 7137 477 I 1556
6240 140 SH DEFINITE
72 METERS 46 METERS 66 METERS
66 METERS YES
ICE CONTACT --- ANDREWS 1967
7009 7735 463 I 486
5750 250 SH POSSIBLY
60 METERS 55 METERS 55 METERS
96 METERS NO
ICE FAR AWAY --- ANDREWS 1967
7236 9520 121 GSC652
5960 140 SH FAIRLY SURE
27 METERS 12 METERS 21 METERS
--- NO
--- --- GSC6 RC 1967

```
7540 8437  14   S432
     6100   125   BO  FAIRLY SURE
          17 METERS   11 METERS   11 METERS
               76 METERS   NO
                    ICE FAR AWAY ---     BARR ARCTIC71$


PRINT:SAME FOR ITEMS WITH LATITUDE, FROM 5800 TO 7600
AND LONGITUDE, FROM
6000 TO 10000 AND C14 DATE, FROM 5250 TO 5750#

NO. OF ITEMS IN QUERY RESPONSE =   20
NO. OF ITEMS IN THE DATA BANK = 1044
PERCENTAGE OF RESPONSE/TOTAL DATA BANK =  1.92

6412 8150  56   GX1067
     5440   360   SH  LIKELY
          84 METERS   76 METERS   80 METERS
               ---         NO
                    ICE FAR AWAY ---     WAGNER 67   $
6431 9603  92   GSC299
     5480   150   SH  FAIRLY SURE
          94 METERS   90 METERS   90 METERS
               130 METERS  NO
                    ICE FAR AWAY ---     GSC5 RC 1966
6448 8259  228  S    13
     5600   300   SH  FAIRLY SURE
          61 METERS   52 METERS   56 METERS
               155 METERS  NO
                    ICE FAR AWAY ---     BIRD70
6448 8259  337  S13
     5600   300   SH  LIKELY
          65 METERS   52 METERS   60 METERS
               ---         NO
                    ICE FAR AWAY ---     ANDREWS GB1967
6610 9014  311  GSC41
     5470   140   SH  LIKELY
          65 METERS   56 METERS   61 METERS
               122 METERS  NO
                    ICE FAR AWAY ---     GSC1  RC 1962
6723 6455  455  GX 1824
     5330   450   SH  LIKELY
          22 METERS   16 METERS   18 METERS
               18 METERS   YES
                    ICE CONTACT  ---     ---
6836 6850  464  I  2411
     5380   185   SH  DEFINITE
          38 METERS   31 METERS   34 METERS
               34 METERS   YES
                    ICE CONTACT  ---     ANDREWS 1967
```

```
6858 6834  460  I  2548
     5580   130   SH  DEFINITE
          22 METERS   18 METERS   18 METERS
               78 METERS   NO
                    ICE FAR AWAY ---     ANDREWS 1967
6907 7502  462  I  1831
     5570   130   SH  DEFINITE
          68 METERS   64 METERS   64 METERS
               83 METERS   NO
                    ICE FAR AWAY ---     ANDREWS 1967
6916 7415  580  F3
     5500   200   GE  FAIRLY SURE
          54 METERS   50 METERS   50 METERS
               50 METERS   YES
                    ICE CONTACT  ---     ANDREWS70AAR
6928 7531  453  I  1833
     5270   140   SH  DEFINITE
          71 METERS   51 METERS   67 METERS
               1?4 METERS   NO
                    ICE FAR AWAY ---     ANDREWS 1967
7001 7130  456  I  1321
     5390   150   SH  LIKELY
          41 METERS   37 METERS   ? METERS
               66 METERS   NO
                    ICE FAR AWAY ---     ANDREWS 1967
7009 7735  463  I   486
     5750   250   SH  POSSIBLY
          60 METERS   55 METERS   55 METERS
               96 METERS   NO
                    ICE FAR AWAY ---     ANDREWS 1967
7016 7143  451  I  1243
     5560   250   SH  LIKELY
          31 METERS   27 METERS   0 METERS
               57 METERS   NO
                    ICE FAR AWAY ---     ANDREWS 1967
7111 7503  448  GSC1163
     5500   180   SH  LIKELY
          35 METERS   29 METERS   31 METERS
               44 METERS   NO
                    ICE NEARBY   ---     GSC RC 1971
7159 7915  458  L  762C
     5400   200   SH  DEFINITE
          32 METERS   4 METERS   28 METERS
               77 METERS   NO
                    ICE FAR AWAY ---     ANDREWS 1967
7203 8107  454  I  1319
     5710   200   SH  FAIRLY SURE
          66 METERS   17 METERS   61 METERS
               17 METERS   NO
                    ICE FAR AWAY ---     ANDREWS 1967
```

```
7540 8436  13   S431
     5280   100   DW  FAIRLY SURE
          15 METERS   11 METERS   11 METERS
               76 METERS   NO
                    ICE FAR AWAY ---     BARR ARCTIC71$
7540 8436  641  S431
     5280   100   DW  FAIRLY SURE
          15 METERS   11 METERS   11 METERS
               ---         NO
                    ICE FAR AWAY ---     BLAKE CJES1970
7558 8958  203  GSC1072
     5250   130   DR  FAIRLY SURE
          29 METERS   26 METERS   26 METERS
               ---         NO
                    ICE FAR AWAY ---    GSC11RC 1971


PRINT:SAME FOR ITEMS WITH LATITUDE, FROM 5800 TO 7600
AND LONGITUDE, FROM
6000 TO 10000 AND C14 DATE, FROM 4750 TO 5250#

NO. OF ITEMS IN QUERY RESPONSE =   23
NO. OF ITEMS IN THE DATA BANK = 1044
PERCENTAGE OF RESPONSE/TOTAL DATA BANK =  2.20

5950 8000  221  I  2547
     4960   130   SH  DEFINITE
          58 METERS   50 METERS   55 METERS
               155 METERS  NO
                    ICE FAR AWAY ---     ANDREWS67
5950 8000  354  12547
     4960   130   SH  LIKELY
          58 METERS   50 METERS   55 METERS
               155 METERS  NO
                    ICE FAR AWAY ---     ANDREWS GB1967
6210 7558  589  N   284
     5230   130   SH  FAIRLY SURE
          18 METERS   13 METERS   15 METERS
               140 METERS  NO
                    ICE FAR AWAY ---     MATTHEWS67
6213 7538  150  GSC812
     4770   140   OR  FAIRLY SURE
          30 METERS   24 METERS   28 METERS
               104 METERS  NO
                    ICE FAR AWAY ---     GSC7 RC 1968
6735 6519  432  GAK3091
     4950   140   SH  FAIRLY SURE
          12 METERS   5 METERS    9 METERS
               17 METERS   NO
                    ICE FAR AWAY ---     ---
```

```
6749 6611   28   GAK3724
     4810    110   SH  LIKELY
          10 METERS    2 METERS     8 METERS
               49 METERS   NO
                    ICE FAR AWAY ---      MILLER  UP
6832 6808   461   I  2549
     5100    120   SH  DEFINITE
          18 METERS   14 METERS   15 METERS
               75 METERS   NO
                    ICE FAR AWAY ---      ANDREWS 1967
6847 6627   27   GAK3723
     5200    100   SH  LIKELY
          25 METERS   17 METERS   22 METERS
               ---         NO
                    ICE FAR AWAY ---      MILLER  UP
6848 6924   446   I  3066
     4850    120   SH  FAIRLY SURE
          39 METERS   13 METERS   37 METERS
               37 METERS   YES
                    ICE CONTACT  ---      ANDREWSETA1970
6852 6927   429   I  2442
     4990    175   SH  FAIRLY SURE
          43 METERS    9 METERS   40 METERS
               40 METERS   YES
                    ICE CONTACT  ---      ANDREWS 1967
6917 7410   579   F4
     5200    200   GE  FAIRLY SURE
          48 METERS   45 METERS   45 METERS
               45 METERS   YES
                    ICE CONTACT  ---      ANDREWS70AAR
6920 7359   577   F5
     5000    200   GE  FAIRLY SURE
          47 METERS   44 METERS   44 METERS
               44 METERS   YES
                    ICE CONTACT  ---      ANDREWS70AAR
6928 7003   450   I  2696
     5190    120   SH  DEFINITE
          43 METERS   29 METERS   40 METERS
               40 METERS   YES
                    ICE NEARBY   ---      ANDREWS 1967
6955 6843   434   I  2961
     4830    120   OR  DEFINITE
          11 METERS    4 METERS    9 METERS
               21 METERS   NO
                    ICE FAR AWAY ---      LOKEMUNPUBL
```

```
6955 7654  459  I  1244
     5070   450   SH  FAIRLY SURE
          46 METERS   43 METERS   43 METERS
               73 METERS   NO
                    ICE FAR AWAY ---     ANDREWS 1967
7001 7133  435  I  1670
     4770   140   SH  POSSIBLY
          22 METERS   16 METERS   20 METERS
               66 METERS   NO
                    ICE FAR AWAY ---     ANDREWS 1967
7001 7133  436  I  1931
     4920   180   SH  DEFINITE
          23 METERS   16 METERS   20 METERS
               66 METERS   NO
                    ICE FAR AWAY ---     ANDREWS 1967
7001 7133  438  I  1669
     4770   140   SH  DEFINITE
          24 METERS   18 METERS   22 METERS
               66 METERS   NO
                    ICE FAR AWAY ---     ANDREWS 1967
7121 7253  457  I  1238
     5070   200   SH  LIKELY
          20 METERS   17 METERS   17 METERS
               66 METERS   NO
                    ICE FAR AWAY ---     ANDREWS 1967
7156 7835  440  I  1245
     4875   350   SH  DEFINITE
          40 METERS   38 METERS   38 METERS
               78 METERS   NO
                    ICE FAR AWAY ---     ANDREWS 1967
7442 9450  645  W127
     5050   350   SH  POSSIBLY
          21 METERS   18 METERS   0 METERS
               ---        NO
                    ICE FAR AWAY ---     BLAKE CJES1970
7541 9848  646  GSC783
     4750   140   SH  POSSIBLY
          28 METERS   24 METERS   26 METERS
               ---        NO
                    ICE FAR AWAY ---     BLAKE CJES1970
7558 8958  203  GSC1072
     5250   130   DR  FAIRLY SURE
          29 METERS   26 METERS   26 METERS
               ---        NO
                    ICE FAR AWAY ---     GSC11RC 1971
```

```
PRINT:SAME FOR ITEMS WITH LATITUDE, FROM 5800 TO 7600
AND LONGITUDE, FROM
6000 TO 10000 AND C14 DATE, FROM 4250 TO 4750*

NO. OF ITEMS IN QUERY RESPONSE =   10
NO. OF ITEMS IN THE DATA BANK = 1044
PERCENTAGE OF RESPONSE/TOTAL DATA BANK =    .96

6239 6939  635  GAK1281
     4460   100   OR  LIKELY
          15 METERS   14 METERS   0 METERS
               ---         NO
                    ICE FAR AWAY ---     BLAKE CJES1970
6836 6855  445  I  2582
     4590   115   SH  DEFINITE
          25 METERS   10 METERS   23 METERS
               34 METERS   NO
                    ICE NEARBY   ---     ANDREWS 1967
6852 6927  430  I  2584
     4430   110   SH  FAIRLY SURE
          27 METERS   19 METERS   26 METERS
               40 METERS   NO
                    ICE NEARBY   ---     ANDREWS 1967
6853 6901  428  I  2413
     4420   110   SH  FAIRLY SURE
          22 METERS   18 METERS   21 METERS
               40 METERS   NO
                    ICE FAR AWAY ---     ANDREWS 1967
6909 9359  369  GSC45
     4460   60    SH  LIKELY
          25 METERS   24 METERS   24 METERS
               190 METERS  NO
                    ICE FAR AWAY ---     GSC1  RC 1962
7001 7133  437  I  1671
     4270   140   SH  DEFINITE
          25 METERS   18 METERS   24 METERS
               66 METERS   NO
                    ICE FAR AWAY ---     ANDREWS 1967
7009 7735  443  I   487
     4700   210   SH  FAIRLY SURE
          23 METERS   21 METERS   21 METERS
               96 METERS   NO
                    ICE FAR AWAY ---     ANDREWS 1967
7152 7833  441  I  1318
     4400   490   SH  POSSIBLY
          17 METERS   14 METERS   16 METERS
               88 METERS   NO
                    ICE FAR AWAY ---     ANDREWS 1967
```

```
7538 8428  12   S430
     4300   95    PT  POSSIBLY
          27 METERS   26 METERS   26 METERS
               76 METERS   NO
                    ICE FAR AWAY ---     BARR ARCTIC71$
7541 9848  646  GSC783
     4750   140   SH  POSSIBLY
          28 METERS   24 METERS   26 METERS
               ---        NO
                    ICE FAR AWAY ---     BLAKE CJES1970
```

PRINT:SAME FOR ITEMS WITH LATITUDE, FROM 5800 TO 7600
AND LONGITUDE, FROM
6000 TO 10000 AND C14 DATE, FROM 3750 TO 4250*

NO. OF ITEMS IN QUERY RESPONSE =   16
NO. OF ITEMS IN THE DATA BANK = 1044
PERCENTAGE OF RESPONSE/TOTAL DATA BANK = 1.53

```
6207 7438  361  NPL71
     3900   125   SH  LIKELY
          12 METERS   10 METERS   12 METERS
               ---        NO
                    ICE FAR AWAY ---     NPL 111 RC1965
6207 7438  592  NPL  71
     3900   125   SH  FAIRLY SURE
          12 METERS   10 METERS   12 METERS
               140 METERS  NO
                    ICE FAR AWAY ---     MATTHEWS67
6239 6939  444  P   707
     4067   73    --- FAIRLY SURE
          11 METERS   12 METERS   10 METERS
               93 METERS   NO
                    ICE FAR AWAY ---     ESK SITE ARC71
6239 6939  634  P707
     4067   73    OR  LIKELY
          16 METERS   15 METERS   0 METERS
               ---        NO
                    ICE FAR AWAY ---     BLAKE CJES1970
6244 6941  423  P   708
     3814   69    --- FAIRLY SURE
          16 METERS   18 METERS   16 METERS
               93 METERS   NO
                    ICE FAR AWAY ---     ESK SITE ARC71
6254 6951  422  GSC 596
     3750   140   SH  SMALL CHANCE
          3 METERS    3 METERS    0 METERS
               93 METERS   NO
                    ICE FAR AWAY ---     GSCRCVI BLAKE
```

```
6345 6832  447  GSC 849
     4140   130   --- DEFINITE
          14 METERS   15 METERS   13 METERS
               30 METERS   NO
                    ICE FAR AWAY ---     ESK SITE ARC71
6832 6801  419  I  2585
     3850   105   SH  FAIRLY SURE
          5 METERS    2 METERS    5 METERS
               79 METERS   NO
                    ICE FAR AWAY ---     ANDREWS 1967
6843 6910  433  I  2546
     4050   130   SH  FAIRLY SURE
          21 METERS   15 METERS   20 METERS
               20 METERS   YES
                    ICE CONTACT  ---     ANDREWS 1967
6847 6837  415  I  2586
     3890   107   SH  LIKELY
          8 METERS    3 METERS    8 METERS
               62 METERS   NO
                    ICE NEARBY   ---     ANDREWS 1967
6906 7448  442  GSC 557
     4000   140   SH  DEFINITE
          27 METERS   3 METERS    26 METERS
               83 METERS   NO
                    ICE FAR AWAY ---     ANDREWS 1967
6910 8359  250  P  207
     3958   168   BO  LIKELY
          47 METERS   50 METERS   46 METERS
               137 METERS  NO
                    ICE FAR AWAY ---     FARRAND62ISOTI

6910 8359  427  P   207
     3958   168   --- FAIRLY SURE
          24 METERS   51 METERS   23 METERS
               134 METERS  NO
                    ICE FAR AWAY ---     ESK SITE ARC71
6937 7001  439  I  1597
     4090   150   SH  DEFINITE
          21 METERS   14 METERS   20 METERS
               68 METERS   NO
                    ICE FAR AWAY ---     ANDREWS 1967
7001 7133  412  I  1668
     3830   140   SH  DEFINITE
          19 METERS   17 METERS   19 METERS
               66 METERS   NO
                    ICE FAR AWAY ---     ANDREWS 1967
7153 8055  431  I  1320
     4010   440   SH  LIKELY
          22 METERS   18 METERS   21 METERS
               54 METERS   NO
                    ICE FAR AWAY ---     ANDREWS 1967
```

```
PRINT:SAME FOR ITEMS WITH LATITUDE, FROM 5800 TO 7600

AND LONGITUDE, FROM
6000 TO 10000 AND C14 DATE, FROM 3250 TO 3750*

NO. OF ITEMS IN QUERY RESPONSE =   20
NO. OF ITEMS IN THE DATA BANK = 1044
PERCENTAGE OF RESPONSE/TOTAL DATA BANK =  1.92

5950 8000  219  1  2417
     3530   110   SH  DEFINITE
          21 METERS    10 METERS   21 METERS
               155 METERS  NO
                    ICE FAR AWAY ---     ANDREWS67
5950 8000  351  12417
     3530   110   SH  FAIRLY SURE
          21 METERS    10 METERS   21 METERS
               ---         NO
                    ICE FAR AWAY ---     ANDREWS GB1967
6230 7740  587  MEEVS 6
     3500   0     EK  LIKELY
          28 METERS    32 METERS   28 METERS
               140 METERS  NO
                    ICE FAR AWAY ---     ANDREWSEA71  $
6239 6937  425  M  1531
     3480   200   --- FAIRLY SURE
          9 METERS     11 METERS   9 METERS
               93 METERS   NO
                    ICE FAR AWAY ---     ESK SITE ARC71
6239 6937  633  GSC1051
     3390   210   OR  LIKELY
          18 METERS    18 METERS   0 METERS
               ---         NO
                    ICE FAR AWAY ---     BLAKE CJES1970
6239 6939  424  P   710
     3577   69    --- FAIRLY SURE
          12 METERS    14 METERS   12 METERS
               93 METERS   NO
                    ICE FAR AWAY ---     ESK SITE ARC71
6254 6951  422  GSC 596
     3750   140   SH  SMALL CHANCE
          3 METERS     3 METERS    0 METERS
               93 METERS   NO
                    ICE FAR AWAY ---     GSCRCVI BLAKE
6411 8311  216  S   12
     3670   270   SH  FAIRLY SURE
          36 METERS    32 METERS   36 METERS
               155 METERS  NO
                    ICE FAR AWAY ---     LEE60
```

```
6411 8311  336  S12
     3670   270   SH  LIKELY
          32 METERS   32 METERS   32 METERS
               ---          NO
                    ICE FAR AWAY ---     ANDREWS GB1967
6735 6519  411  GSC1507
     3570   140   PT  FAIRLY SURE
          5 METERS    7 METERS    5 METERS
               22 METERS   NO
                    ICE FAR AWAY ---     ---
6822 9747  294  I-178GS
     3690   120   SH  LIKELY
          22 METERS   22 METERS   22 METERS
               174 METERS  NO
                    ICE FAR AWAY ---     I-2   RC 1962
6858 6903  421  Y  1831
     3580   120   SH  DEFINITE
          5 METERS    1 METERS    5 METERS
               87 METERS   NO
                    ICE FAR AWAY ---     ANDREWS 1967
6917 7415  410  I  2830
     3585   140   SH  FAIRLY SURE
          19 METERS   14 METERS   19 METERS
               52 METERS   NO
                    ICE FAR AWAY ---     ANDREWS 1967
6937 7001  413  I  1601
     3530   130   SH  LIKELY
          17 METERS   13 METERS   17 METERS
               68 METERS   NO
                    ICE FAR AWAY ---     ANDREWS 1967
6937 7001  414  I  1600
     3520   230   SH  FAIRLY SURE
          15 METERS   11 METERS   15 METERS
               68 METERS   NO
                    ICE FAR AWAY ---     ANDREWS 1967
6950 7020  416  GSC 584
     3450   170   PT  FAIRLY SURE
          6 METERS    6 METERS    6 METERS
               61 METERS   NO
                    ICE NEARBY   ---     ANDREWS 1967
6956 7702  418  I  1247
     3550   200   WO  DEFINITE
          18 METERS   18 METERS   18 METERS
               70 METERS   NO
                    ICE FAR AWAY ---     ANDREWS 1967

7131 8433  417  GSC 190
     3480   130   SH  LIKELY
          3 METERS    3 METERS    3 METERS
               67 METERS   NO
                    ICE FAR AWAY ---     GSCRCIVCRAIG
```

```
7152 7833  420  I  1317
     3600   480   SH  DEFINITE
          16 METERS   15 METERS   16 METERS
               88 METERS   NO
                    ICE FAR AWAY ---     ANDREWS 1967
7550 8330  739  INFER
     3500   500   CU  LIKELY
          9 METERS    12 METERS   9 METERS
               ---         NO
                    ICE FAR AWAY ---     ANDREWSETAL71$



PRINT:SAME FOR ITEMS WITH LATITUDE. FROM 5800 TO 7600
AND LONGITUDE, FROM
6000 TO 10000 AND C14 DATE, FROM 2750 TO 3250*

NO. OF ITEMS IN QUERY RESPONSE =   15
NO. OF ITEMS IN THE DATA BANK = 1044
PERCENTAGE OF RESPONSE/TOTAL DATA BANK =  1.44

5837 9349  194  GSC685
     3180   140   SH  FAIRLY SURE
          38 METERS   38 METERS   38 METERS
               ---         NO
                    ICE FAR AWAY ---     GSC11RC 1971
5844 9405  195  GSC261
     3040   130   SH  SMALL CHANCE
          23 METERS   23 METERS   23 METERS
               ---         NO
                    ICE FAR AWAY ---     GSC11RC 1971
5850 9355  63   GX1072
     3190   80    SH  FAIRLY SURE
          32 METERS   30 METERS   32 METERS
               150 METERS  YES
                    ICE FAR AWAY ---     WAGNER 67   $
5900 9400  62   GX1065
     2800   110   SH  FAIRLY SURE
          40 METERS   38 METERS   40 METERS
               150 METERS  YES
                    ICE FAR AWAY ---     WAGNER 67   $
6213 7539  151  GSC818
     2840   160   OR  FAIRLY SURE
          6 METERS    4 METERS    6 METERS
               104 METERS  NO
                    ICE FAR AWAY ---     GSC7 RC 1968
6244 6941  426  P   699
     3043   63    --- DEFINITE
          8 METERS    10 METERS   8 METERS
               93 METERS   NO
                    ICE FAR AWAY ---     ESK SITE ARC71
```

```
6910 8359  251  P  213
     2910   129   BO  FAIRLY SURE
          17 METERS   21 METERS   17 METERS
               137 METERS  NO
                    ICE FAR AWAY ---     FARRAND62ISOTI
6910 8359  408  P   213
     2910   129   --- FAIRLY SURE
          15 METERS   22 METERS   15 METERS
               134 METERS  NO
                    ICE FAR AWAY ---     ESK SITE ARC71
6920 8220  749  P213
     2910   129   --- LIKELY
          19 METERS   22 METERS   19 METERS
               ---         NO
                    ICE FAR AWAY ---     ANDREWSETAL71$
6922 7354  469  GSC 564
     3100   150   SH  LIKELY
          16 METERS   13 METERS   16 METERS
               42 METERS   NO
                    ICE FAR AWAY ---     ANDREWS 1967
6937 7001  398  I  1555
     2800   146   SH  DEFINITE
          8 METERS    9 METERS    8 METERS
               68 METERS   NO
                    ICE FAR AWAY ---     ANDREWS 1967
6937 7001  405  1  1599
     2990   140   SH  DEFINITE
          9 METERS    8 METERS    9 METERS
               68 METERS   NO
                    ICE FAR AWAY ---     ANDREWS 1967
6951 7029  406  GSC 583
     2770   140   SH  DEFINITE
          6 METERS    6 METERS    6 METERS
               61 METERS   NO
                    ICE FAR AWAY ---     ANDREWS 1967
7153 7820  401  GSC 654
     2780   140   SH  LIKELY
          2 METERS    2 METERS    2 METERS
               ---         NO
                    ICE FAR AWAY ---     ANDREWS 1967
7541 8439  11   S433
     2900   85    BO  FAIRLY SURE
          3 METERS    3 METERS    3 METERS
               76 METERS   NO
                    ICE FAR AWAY ---     BARR ARCTIC71$
```

```
PRINT:SAME FOR ITEMS WITH LATITUDE, FROM 5800 TO 7600
 AND LONGITUDE, FROM
6000 TO 10000 AND C14 DATE, FROM 2250 TO 2750*

NO. OF ITEMS IN QUERY RESPONSE =     9
NO. OF ITEMS IN THE DATA BANK = 1044
PERCENTAGE OF RESPONSE/TOTAL DATA BANK =    .86

5842 9351   196   GSC683
     2320    130     SH   FAIRLY SURE
          27 METERS    27 METERS    27 METERS
               ---            NO
                    ICE FAR AWAY ---      GSC11RC 1971
6215 7525   586   GSC 701
     2670    0       --- FAIRLY SURE
          13 METERS    17 METERS    13 METERS
               140 METERS  NO
                    ICE FAR AWAY ---      GSCRC          $
6230 7740   565   UHITUK6
     2650    250    EK   LIKELY
          14 METERS    18 METERS    14 METERS
               140 METERS  NO
                    ICE FAR AWAY ---      ANDREWSEA71   $
6239 6937   399   M   1535
     2410    120    --- DEFINITE
          10 METERS    12 METERS    10 METERS
               93 METERS   NO
                    ICE FAR AWAY ---      ESK SITE ARC71
6239 6939   407   P    698
     2608    50     --- DEFINITE
          5 METERS     7 METERS     5 METERS
               93 METERS   NO
                    ICE FAR AWAY ---      ESK SITE ARC71
6335 8200   230   P     76
     2632    128    BO   FAIRLY SURE
          17 METERS    21 METERS    17 METERS
               155 METERS  NO
                    ICE FAR AWAY ---      ANDREWSEA71   $
6825 6648   402   GAK1992
     2400    90     BO   LIKELY
          2 METERS     3 METERS     2 METERS
               35 METERS   NO
                    ICE NEARBY   ---      ANDREWS 1967
6827 6652   753   GAK1992
     2400    90     BO   LIKELY
          1 METERS     3 METERS     1 METERS
               ---            NO
                    ICE FAR AWAY ---      ANDREWSETAL71$
```

```
7540 8437  16   13231
     2450   90   PT  FAIRLY SURE
          4 METERS    4 METERS    4 METERS
               76 METERS   NO
                    ICE FAR AWAY ---      BARR ARCTIC71$
```

PRINT:SAME FOR ITEMS WITH LATITUDE, FROM 5800 TO 7600
AND LONGITUDE, FROM
6000 TO 10000 AND C14 DATE, FROM 1750 TO 2250*

NO. OF ITEMS IN QUERY RESPONSE =   11
NO. OF ITEMS IN THE DATA BANK = 1044
PERCENTAGE OF RESPONSE/TOTAL DATA BANK = 1.05

```
5845 9359  197  GSC723
     2120   130   SH  FAIRLY SURE
          22 METERS   22 METERS   22 METERS
               ---         NO
                    ICE FAR AWAY ---      GSC11RC 1971
6212 7310  584  NIAQUN4
     2200   100   EK  LIKELY
          8 METERS    12 METERS   6 METERS
               140 METERS  NO
                    ICE FAR AWAY ---      ANDREWSEA71  $
6230 7740  583  EETEEV6
     1800   200   EK  LIKELY
          8 METERS    12 METERS   8 METERS
               140 METERS  NO
                    ICE FAR AWAY ---      ANDREWSEA71  $
6239 6937  400  M   1534
     2200   120   --- DEFINITE
          6 METERS    8 METERS    6 METERS
               93 METERS   NO
                    ICE FAR AWAY ---      ESK SITE ARC71
6320 8330  232  WALIS20
     2200   100   EK  FAIRLY SURE
          12 METERS   15 METERS   12 METERS
               ---         NO
                    ICE FAR AWAY ---      ANDREWSEA71  $
6333 8539  88   M1085
     2225   200   OR  FAIRLY SURE
          12 METERS   12 METERS   12 METERS
               127 METERS  NO
                    ICE FAR AWAY ---      CRANE+GRIFFEN
6335 8200  231  P    77
     2191   120   BO  FAIRLY SURE
          12 METERS   14 METERS   12 METERS
               155 METERS  NO
                    ICE FAR AWAY ---      ANDREWSEA71  $
```

```
6418 9546  312  GSC23
     1800   60    OR  POSSIBLY
           9 METERS    9 METERS    9 METERS
                ---          NO
                     ICE FAR AWAY ---     GSC1 PC 1962
6758 6517  403  GAK2771
     2090   100   OR  SMALL CHANCE
           3 METERS    1 METERS    3 METERS
                30 METERS   NO
                     ICE FAR AWAY ---     ---
6902 7502  404  I   489
     2050   170   SH  FAIRLY SURE
           9 METERS    9 METERS    9 METERS
                83 METERS   NO
                     ICE FAR AWAY ---     ANDREWS 1967
6906 7447  392  I   1830
     1950   100   SH  DEFINITE
           6 METERS    3 METERS    6 METERS
                83 METERS   NO
                     ICE FAR AWAY ---     ANDREWS 1967


PRINT:SAME FOR ITEMS WITH LATITUDE, FROM 5800 TO 7600
AND LONGITUDE, FROM
6000 TO 10000 AND C14 DATE, FROM 1250 TO 1750*

NO. OF ITEMS IN QUERY RESPONSE =     5
NO. OF ITEMS IN THE DATA BANK = 1044
PERCENTAGE OF RESPONSE/TOTAL DATA BANK =    .48

6210 7548  588  GSC 537
     1600   140   PT  LIKELY
           6 METERS    8 METERS    6 METERS
                140 METERS  NO
                     ICE FAR AWAY ---     MATTHEWS67
6237 6932  394  M   1529
     1470   110   --- DEFINITE
           2 METERS    4 METERS    2 METERS
                92 METERS   NO
                     ICE FAR AWAY ---     ESK SITE ARC71
6258 6940  393  M   1533
     1670   150   --- DEFINITE
           2 METERS    4 METERS    2 METERS
                93 METERS   NO
                     ICE FAR AWAY ---     ESK SITE ARC71
6340 7710  764  INFER
     1300   300   CU  POSSIBLY
           15 METERS   18 METERS   15 METERS
                ---          NO
                     ICE FAR AWAY ---     ANDREWSETAL71$
```

```
7242 7750  395  S   47F
     1380   95    --- DEFINITE
          1 METERS    3 METERS    1 METERS
               ---          NO
                    ICE FAR AWAY ---     ESK SITE ARC71
```

PRINT:SAME FOR ITEMS WITH LATITUDE, FROM 5800 TO 7600

AND LONGITUDE, FROM
6000 TO 10000 AND C14 DATE, FROM 750 TO 1250*

NO. OF ITEMS IN QUERY RESPONSE =   17
NO. OF ITEMS IN THE DATA BANK = 1044
PERCENTAGE OF RESPONSE/TOTAL DATA BANK = 1.63

```
5845 9350  198  GSC682
     1240   130   SH  FAIRLY SURE
          10 METERS   10 METERS   10 METERS
               ---          NO
                    ICE FAR AWAY ---     GSC11RC 1971
5846 9357  199  GSC684
     1020   140   SH  FAIRLY SURE
          6 METERS    6 METERS    6 METERS
               ---          NO
                    ICE FAR AWAY ---     GSC11RC 1971
5950 8000  217  I  2418
     1150   150   SH  FAIRLY SURE
          5 METERS    ? METERS    5 METERS
               155 METERS  NO
                    ICE FAR AWAY ---     ANDREWS67
5950 8000  358  I2418
     1150   100   SH  FAIRLY SURE
          5 METERS    ? METERS    5 METERS
               ---          NO
                    ICE FAR AWAY ---     ANDREWS GB1967
6515 8500  233  SITE 21
     800    0     EK  FAIRLY SURE
          4 METERS    6 METERS    4 METERS
               ---          NO
                    ICE FAR AWAY ---     ANDREWSEA71  $
6667 8645  765  INFER
     900    100   CU  LIKELY
          9 METERS    12 METERS   9 METERS
               ---          NO
                    ICE FAR AWAY ---     ANDREWSETAL71$
```

```
6713 6340  390  GAK3096
     930    100   OR  DEFINITE
          0 METERS     0 METERS    0 METERS
               4 METERS    NO
                    ICE FAR AWAY ---     ---
6735 6518  389  GAK3639
     750    140   OR  DEFINITE
          0 METERS     0 METERS    0 METERS
               17 METERS   NO
                    ICE FAR AWAY ---     ---
6845 8130  359  GSC691
     1020   130   SH  FAIRLY SURE
          7 METERS     7 METERS    7 METERS
               ---         NO
                    ICE FAR AWAY ---     ANDREWS GB1967
6845 8130  396  GSC 691
     1020   130   SH  DEFINITE
          7 METERS     7 METERS    7 METERS
               134 METERS  NO
                    ICE FAR AWAY ---     ANDREWS 1967
6847 8114  143  GSC691
     1020   130   SH  LIKELY
          7 METERS     7 METERS    7 METERS
               ---         NO
                    ICE FAR AWAY ---     GSC7 RC 1968
6910 8359  397  ---
     1100   0     --- FAIRLY SURE
          5 METERS     8 METERS    5 METERS
               134 METERS  NO
                    ICE FAR AWAY ---     ESK SITE ARC71
6920 8220  766  INFER
     1100   0     CU  LIKELY
          5 METERS     8 METERS    5 METERS
               ---         NO
                    ICE FAR AWAY ---     ANDREWSETAL71$
7055 8911  79   GSC239
     940    130   OR  LIKELY
          3 METERS     3 METERS    3 METERS
               ---         NO
                    ICE FAR AWAY ---     GSC4 RC 1965
7055 8911  391  GSC 239
     940    130   WO  FAIRLY SURE
          3 METERS     3 METERS    3 METERS
               ---         NO
                    ICE FAR AWAY ---     GSCRCIVCRAIG
7440 9510  762  INFER
     1200   400   CU  LIKELY
          3 METERS     6 METERS    3 METERS
               ---         NO
                    ICE FAR AWAY ---     ANDREWSETAL71$
```

```
7540 9910  763  GSC148
     1150   160   --- LIKELY
          2 METERS    2 METERS    0 METERS
               ---          NO
                       ICE FAR AWAY ---     ANDREWSETAL71$


PRINT:SAME FOR ITEMS WITH LATITUDE, FROM 5800 TO 7600
AND LONGITUDE, FROM
6000 TO 10000 AND C14 DATE, FROM 250 TO 750#

NO. OF ITEMS IN QUERY RESPONSE =     4
NO. OF ITEMS IN THE DATA BANK = 1044
PERCENTAGE OF RESPONSE/TOTAL DATA BANK =    .38
5900 9353  64   GX1073
     385    80    SH  FAIRLY SURE
          4 METERS    4 METERS    4 METERS
               150 METERS  YES
                       ICE FAR AWAY ---     WAGNER 67   $
6206 7433  372  Y1717
     330    100   OR  FAIRLY SURE
          3 METERS    3 METERS    3 METERS
               ---          NO
                       ICE FAR AWAY ---     YALE 1X RC1969
6735 6518  389  GAK3639
     750    140   OR  DEFINITE
          0 METERS    0 METERS    0 METERS
               17 METERS   NO
                       ICE FAR AWAY ---     ---
6910 8359  767  K 504
     600    150   BO  FAIRLY SURE
          4 METERS    8 METERS    4 METERS
               137 METERS  NO
                       ICE FAR AWAY ---     FARRAND62ISOTI

END

TOTAL RUN TIME IN SECONDS:  31.415
```

Occasional Papers

INSTITUTE OF ARCTIC AND ALPINE RESEARCH

Occasional Paper No. 1: The Taxir Primer, R.C. Brill, 1971.

Occasional Paper No. 2: Present and Paleo-Climatic Influences on the Glacierization and Deglacierization of Cumberland Peninsula, Baffin Island, J. T. Andrews and R. G. Barry, and others, 1972.

Occasional Paper No. 3: Climatic Environment of the East Slope of the Colorado Front Range, R. G. Barry, 1972.

Occasional Paper No. 4: Short-Term Air-Sea Interactions and Surface Effects in the Baffin Bay—Davis Strait Region from Satellite Observations, J. D. Jacobs, R. G. Barry, B. Stankov, and J. Williams, 1972.

Occasional Paper No. 5: Simulation of the Climate at the Last Glacial Maximum Using the NCAR Global Circulation Model, Jill Williams, R. G. Barry, and W. M. Washington, 1973.

Occasional Paper No. 6: Guide to the Moses of Colorado, William A. Weber, 1973.

Occasional Paper No. 7: A Climatological Study of Strong Downslope Winds in the Boulder Area, W. A. R. Brinkmann, 1973.

Occasional Paper No. 8: Environmental Inventory and Land Use Recommendations for Boulder County, Colorado, Richard F. Madole, 1973.

Occasional Paper No. 9: Studies of Climate and Ice Conditions in Eastern Baffin Island, 1971-73, J. D. Jacobs, R. G. Barry, R. S. Bradley, and R. L. Weaver.

Occasional Paper No. 10: Simulation of the Atmospheric Circulation Using the NCAR Global Circulation Model with Present-Day and Glacial Period Boundary Conditions, Jill Williams, 1974.

Occasional Paper No. 11: Solar and Atmospheric Radiation Data for Broughton Island, Eastern Baffin Island, Canada, 1971-1973, John D. Jacobs, 1974.

Occasional Paper No. 12: Deglacial Chronology and Uplift History: Northeastern Sector, Laurentide Ice Sheet, Arthur S. Dyke, 1974.