Reconnaissance geochemical mapping of the Aasiaat region (68° to 68°45′N, 52°45′ to 54°W), West Greenland

Agnete Steenfelt, Anette Petersen
and Else Dam

Open File Series 94/6

February 1994

GRØNLANDS GEOLOGISKE UNDERSØGELSE
Ujarassiortut Kalaallit Nunaanni Misissuisoqarfiat
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Reconnaissance geochemical mapping of the Aasiaat region (68° to 68°45′N, 52°45′ to 54°W), West Greenland

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Abstract

Geochemical mapping by means of analysis of stream sediment and water collected at a density of 1 sample per 20-30 km² has been carried out over the Aasiaat region of West Greenland. The <0.1 mm fraction of the sediment samples was analysed by X-ray fluorescence and instrumental neutron activation techniques and results are reported for 34 major and trace elements. The conductivity and fluoride contents of the water samples were also determined.

The present data constitute a supplement to the results of the geochemical mapping of map sheet 68 V 2 (Steenfelt *et al.*, 1992) east of the present area. The distribution of geochemical anomalies in the survey area indicates possibilities for minor base metal mineralisation associated with supracrustal rocks.

Contents

Introduction

The sampling carried out in the Aasiaat region is part of the Geological Survey of Greenland (GGU) geochemical mapping programme based on drainage samples. The purpose of this programme is to provide reconnaissance geochemical data which may be used together with geophysical and geological information to outline provinces or zones with potential for mineral resources.

Samples were collected during the period August 13th to 18th by A. Petersen and C. Z. Munch-Andersen. The sampling team was based at Aasiaat (Egedesminde) and used an AS 350 (Ecureuil) helicopter for transportation. The field and analytical work was financially supported by the Mineral Resource Administration for Greenland, part of the Danish Ministry of Energy.

The small area was covered in order to complete the geochemical mapping of this part of Greenland and the data presented should be regarded as a supplement to the geochemical mapping of map sheet 68 V 2 (east of the present area), reported in Open File Series 92/7 (Steenfelt *et al.*, 1992). The geochemical maps are presented here with a minimum of text and the reader is referred to the report mentioned above for more information about geology, mineralisation and exploration in the Aasiaat region.

Geology

The area covered is situated in the northern part of the Proterozoic Nagssugtoqidian orogenic belt. The basement of gneiss with supracrustal layers and enclaves is considered to be predominantly of Archaean age (Kalsbeek *et al.*, 1987). A geological map of the area was published by Henderson (1969). An aeromagnetic survey conducted in 1992 covers the Aasiaat region (Thorning, 1993).

Physiography

The surveyed area has a low to moderate relief inland and comprises a fringe of low islands along the the coast. The drainage in the low parts is often poorly developed. As a result a number of the samples represent redistributed soil and seepage water.

Sampling

Four working days and 10.7 helicopter flying-hours were spent during the sampling of 90 sites distributed over 3000 km² including water between islands. On average 24 samples were collected per day at an average density of 1 site per 30 km²; 7 flying minutes were spent per sampling site, which corresponds to 13 flying seconds per km².

The sample sites were selected and marked on aerial photographs prior to the sampling, using criteria such as even distribution of the sites, a reasonable size of upstream drainage area, and a reasonable slope dip.

At each station *c.* 500 g of stream sediment was collected in a paper bag and 100 ml of stream water in a polyethylene bottle. In addition the radioactivity (total gamma-radiation) was measured on the surface of outcrops or stream boulders using a scintillometer (Table 1). To increase the representivity, each stream sediment sample was composed of subsamples from 3 to 7 different sites of sand and silt deposits in the stream bed or banks. Duplicate samples of both sediment and water were collected at 5 localities, which corresponds to 5 % of the total number of sample localities.

Sample preparation and analysis

Sediment. The sample bags were dried at room temperature at the base in Aasiaat and then sent by ship to GGU, Copenhagen. Here the samples were further dried at 65° C and sieved into three grain size fractions using sieve apertures of 1 mm and 0.1 mm. The coarse fraction was discarded, the medium fraction archived, and the fine fraction submitted for analysis. The samples were analysed by the instrumental neutron activation (INA) method for Au and 34 other elements and by X-ray fluorescence spectrometry using pressed powder tablets for 14 trace elements (XRF-trace) at Activation Laboratories Ltd, Canada. They were analysed for major elements at the Geological Survey of Greenland by X-ray fluorescence spectrometry on fused discs, using Na-tetraborate, except Na_2O which was determined by atomic absorption spectrophotometry together with Cu. Some samples did not contain sufficient amounts of fine fraction to permit all three types of analysis, and this explains the different numbers of samples analysed: 90 INA, 86 XRF-trace, and 88 XRF-major.

Water. The water samples (totalling 95) were sent by ship to GGU, Copenhagen, where they were analysed *c.* 2 months after collection. The conductivity and fluoride concentrations were measured (Table 1).

Data presentation

Analytical results from the Aasiaat region are shown in this report as element distribution maps at 1:1 000 000 scale together with summary statistical parameters and histograms of the frequency distribution for each element (Figs 1 to 38). The suite of elements is the same as that reported for map sheet 68 V 2 (Steenfelt *et al.*, 1992). Additional analytical data (some trace elements by XRF from Actlabs) which are obtained in the present survey but not in the survey of 68 V 2 will be published at a later stage when corresponding data from 68 V 2 become available.

Elements with insignificant concentrations, i.e. at or below the detection limit (Table 2), are not presented. In cases where an element has been determined by more than one method, only one of the data sets is presented: that regarded as the most reliable or determined at the lowest detection limit. The major elements are expressed as oxides and the plots represent analytical values recalculated as volatile free components. The amount of volatiles (as determined by loss on ignition) is on average 8.5 % (maximum value is 26 % and minimum 1.8 %). High amounts of volatiles were measured in samples with a high proportion of organic matter.

In the element distribution maps the size of a dot is proportional to the concentration in the sample. The scaling of the dot size is the same as or very close to that used in the report on 68 V 2 (Steenfelt *et al.*, 1992) except for V which is affected by analytical bias. Maximum values are found in the statistical parameters in the figures, and values regarded as geochemical anomalies are shown on the anomaly map (Fig. 38). In any comparison between major element data of the present survey with the survey of 68 V 2 it should be noted that the present data are calculated as volatile-free components while the data from 68 V 2 are not.

Comments on the element distribution patterns

The area covered is too small to reveal regional trends in the geochemical distribution patterns. The most interesting feature is the distribution of anomalies (Fig. 38). In 68 V 2 anomalies for As, Cu, Zn, U and F in water are situated in a WSW trending belt which also comprises a base metal (-gold) prospect (Lersletten; see Nielsen, 1976; Steenfelt, 1992). The anomalies in the centre of the present survey area probably reflect the continuation of this belt of mineralisation. The values for Au are low but the highest Cu value (275 ppm), the easternmost of the Cu anomalies in Fig. 38, indicates Cu mineralisation. The high values of U and F in the zone indicate hydrothermal activity. In the aeromagnetic map (Thorning, 1993) the belt is characterised by a strongly banded anomaly pattern with the same WSW trend.

Acknowledgement

The authors are grateful to Christian Z. Munch-Andersen for sample collection and field assistance. The sampling benefitted greatly from the skill and cooperation of the UNIFLY helicopter pilot Karsten Planck-Madsen.

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Table 1. Instrumentation at the Geological Survey of Greenland

Field measurement of gamma-radiation: Saphymo-Srat SPP-2 scintillometer

Water samples:

Conductivity: Chemotest JK 8800

Fluoride concentration: Orion EA 920 pH/ion analyzer

Table 2. Analytical detection limits

Instrumental Neutron Activation Analysis (Activation Laboratories Ltd)

Au	5.0	ppm	Ag	5.0	ppm	As	2.0	ppm	Ba	100.0	ppm
Br	1.0	ppm	Ca	1.0	%	Co	5.0	ppm	Cr	10.0	ppm
Cs	2.0	ppm	Fe	0.02	%	Hf	1.0	ppm	Hg	1.0	ppm
Ir	5.0	ppm	Mo	5.0	ppm	Na	500.0	ppm	Ni	50.0	ppm
Rb	30.0	ppm	Sb	0.2	ppm	Sc	0.1	ppm	Se	5.0	ppm
Sn	0.01	%	Sr	0.05	%	Ta	1.0	ppm	Th	0.5	ppm
U	0.05	ppm	W	4.0	ppm	Zn	50.0	ppm	La	1.0	ppm
Ce	3.0	ppm	Nd	5.0	ppm	Sm	0.1	ppm	Eu	0.2	ppm
Tb	0.5	ppm	Yb	0.05	ppm	Lu	0.05	ppm			

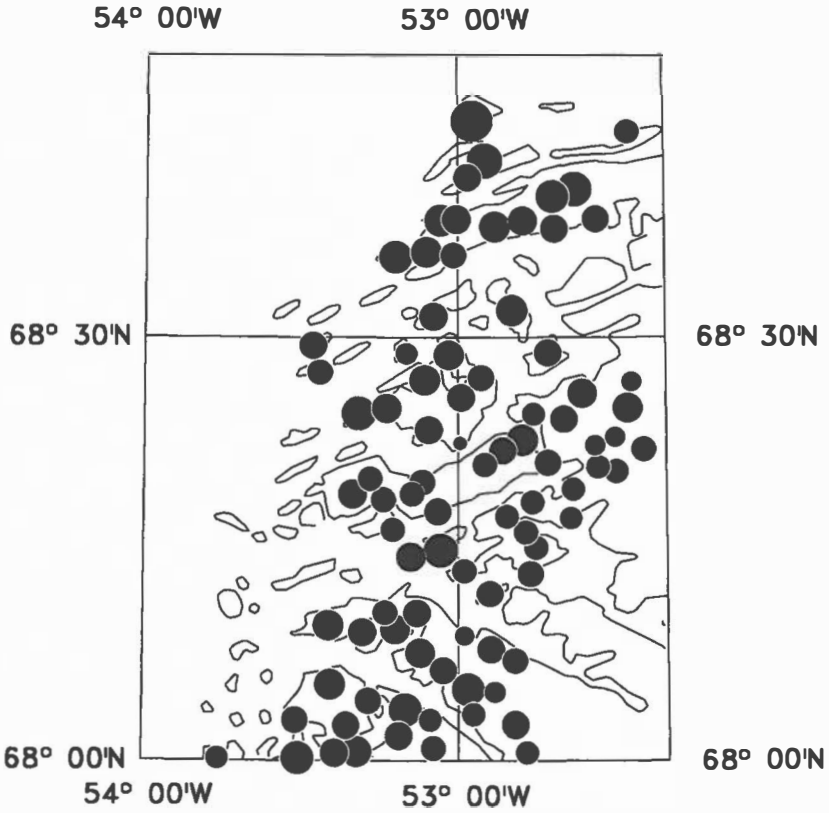
X-ray Fluorescence Spectrometry (pressed powder tablets) (Activation Laboratories Ltd)

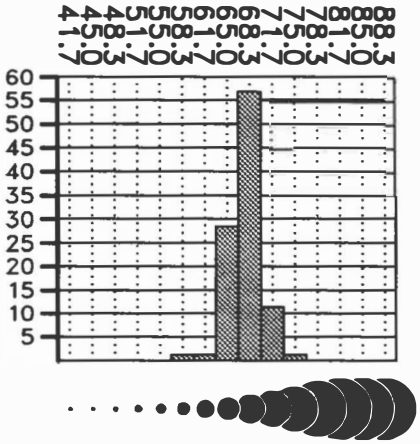
Ba	5.0	ppm	Co	5.0	ppm	Cr	5.0	ppm	Cu	5.0	ppm
Ga	5.0	ppm	Nb	2.0	ppm	Ni	5.0	ppm	Pb	5.0	ppm
Rb	2.0	ppm	Sr	2.0	ppm	V	5.0	ppm	Y	2.0	ppm
Zn	5.0	ppm	Zr	5.0	ppm						

List of figures

Grønlands Geologiske Undersøgelse

SiO_2 in stream sediment





SiO_2 pct

X–ray Fluorescence

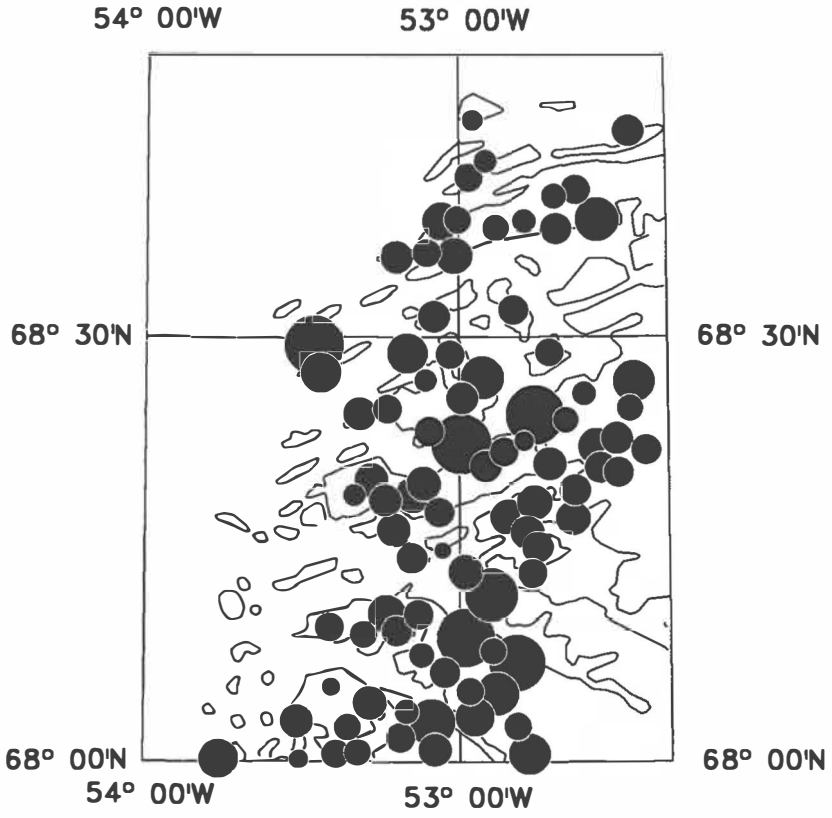
Number of samples:	88
Min. value:	58.8
Max. value:	73.9
Mean:	67.7
Median:	67.8
Variance:	4.7
Std. Dev.:	2.2

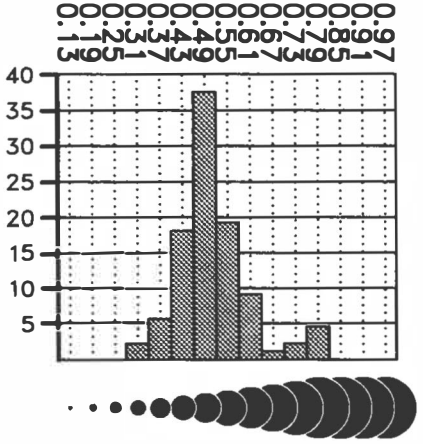
50 km

Fig. 1

Grønlands Geologiske Undersøgelse

TiO_2 in stream sediment





TiO_2 pct

X–ray Fluorescence

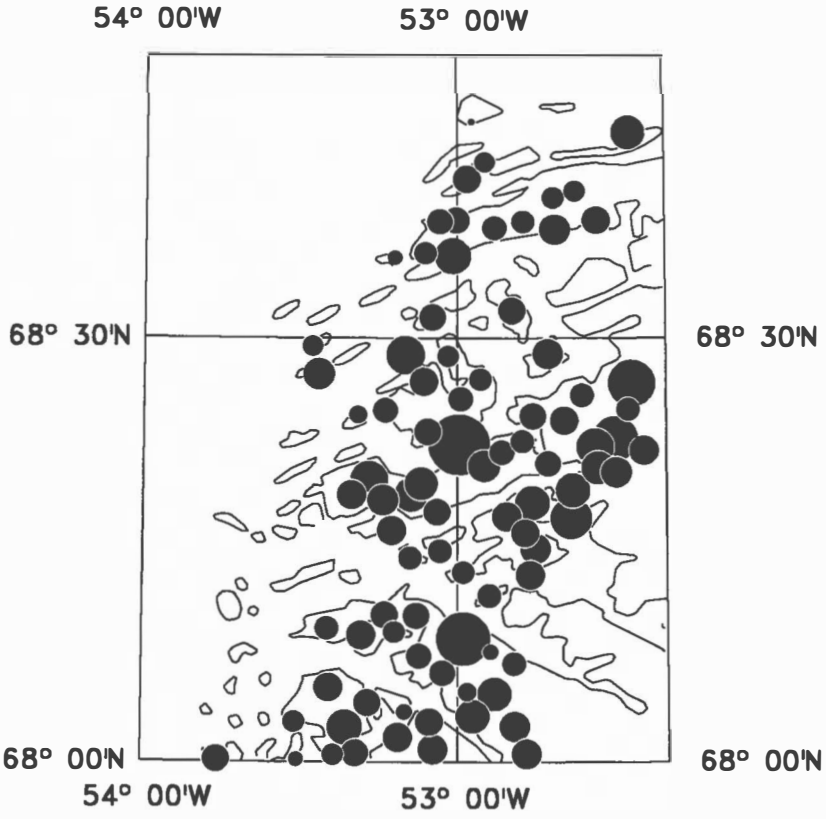
Number of samples:	88
Min. value:	0.33
Max. value:	0.78
Mean:	0.51
Median:	0.50
Variance:	0.01
Std. Dev.:	0.09

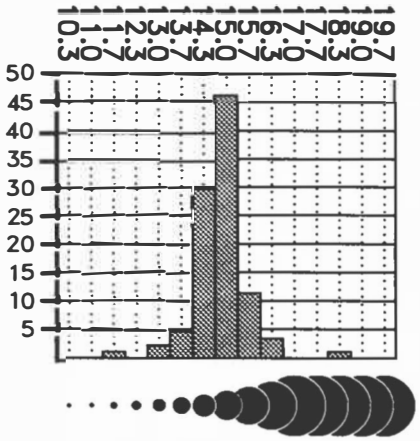
50 km

Fig. 2

Grønlands Geologiske Undersøgelse

Al_2O_3 in stream sediment





X–ray Fluorescence

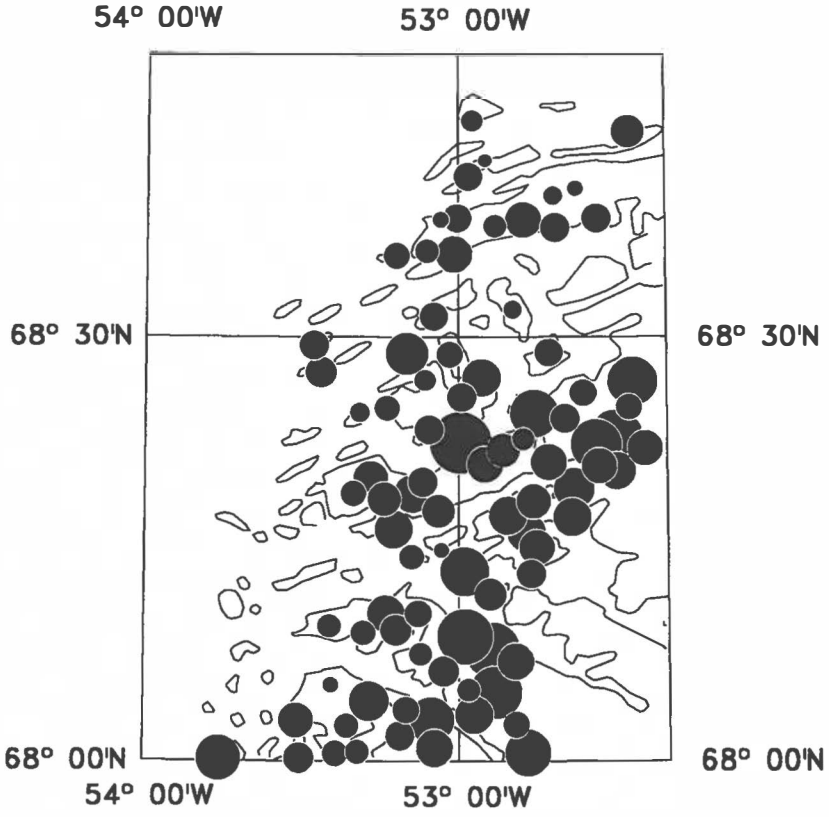
Number of samples:	88
Min. value:	11.6
Max. value:	18.2
Mean:	14.8
Median:	14.8
Variance:	0.6
Std. Dev.:	0.8

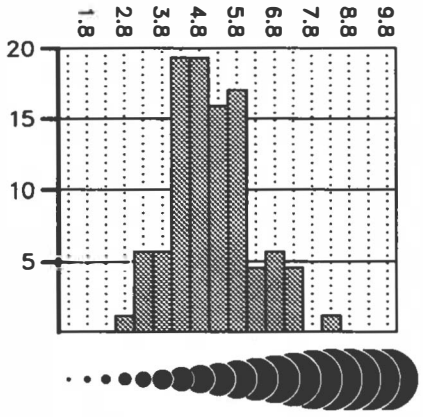
50 km

Fig. 3

Grønlands Geologiske Undersøgelse

Fe_2O_3 in stream sediment





Fe_2O_3 pct

X–ray Fluorescence

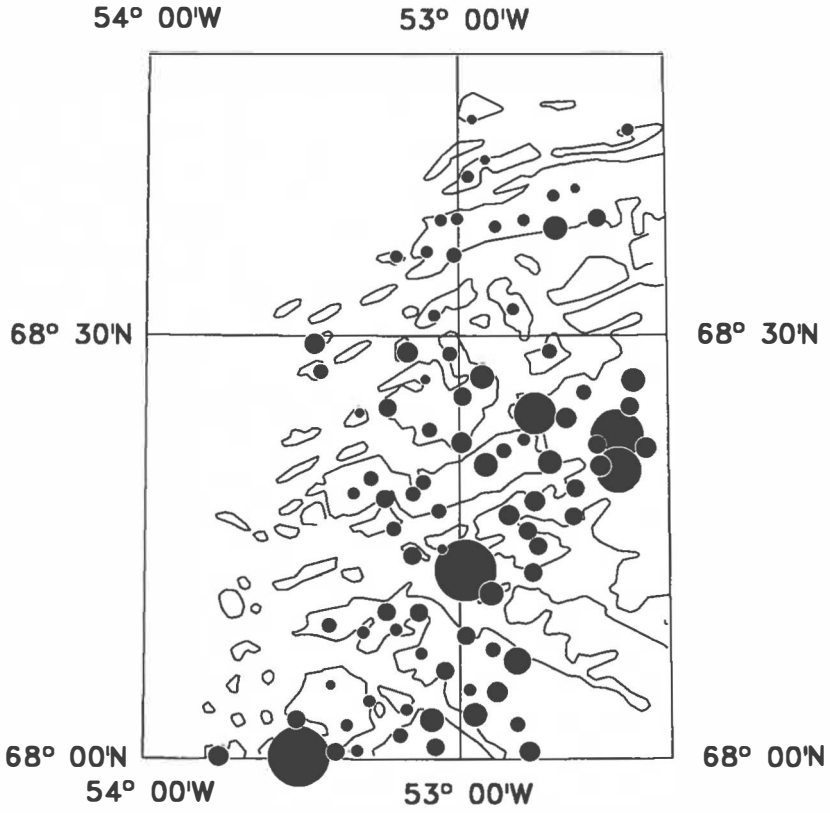
Number of samples:	88
Min. value:	2.8
Max. value:	8.4
Mean:	5.1
Median:	4.9
Variance:	1.2
Std. Dev.:	1.1

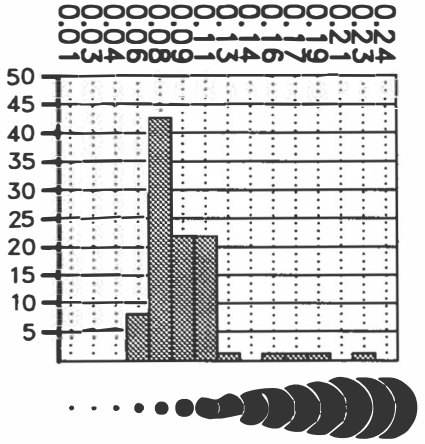
50 km

Fig. 4

Grønlands Geologiske Undersøgelse

MnO in stream sediment





MnO pct

X–ray Fluorescence

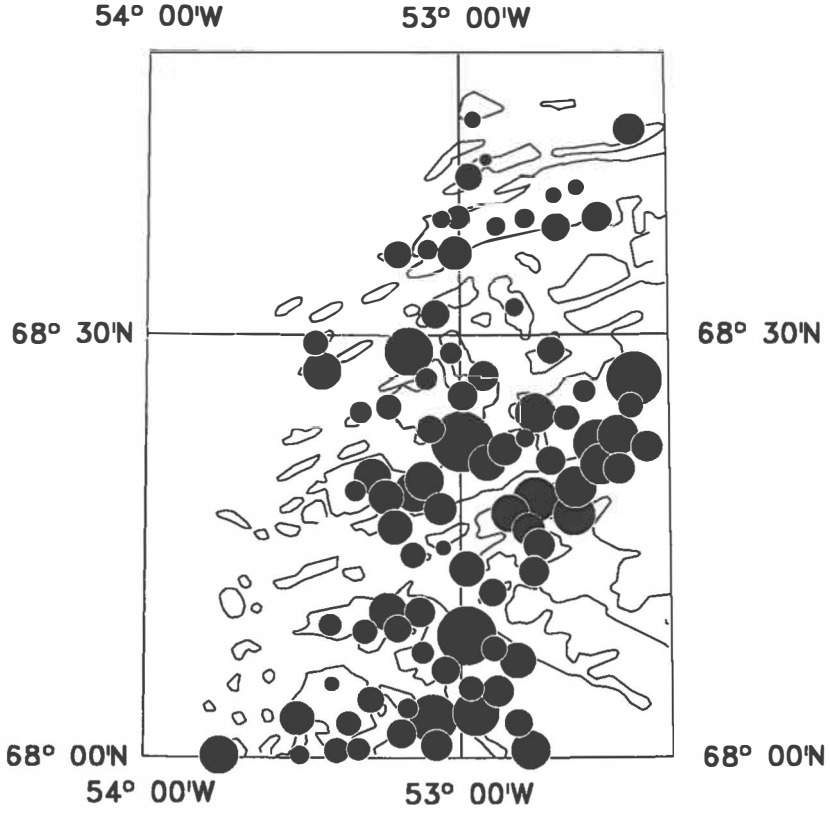
Number of samples:	88
Min. value:	0.06
Max. value:	0.29
Mean:	0.09
Median:	0.08
Variance:	0.00
Std. Dev.:	0.03

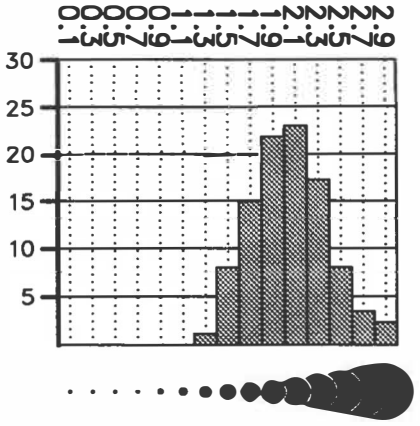
50 km

Fig. 5

Grønlands Geologiske Undersøgelse

MgO in stream sediment





MgO pct

X–ray Fluorescence

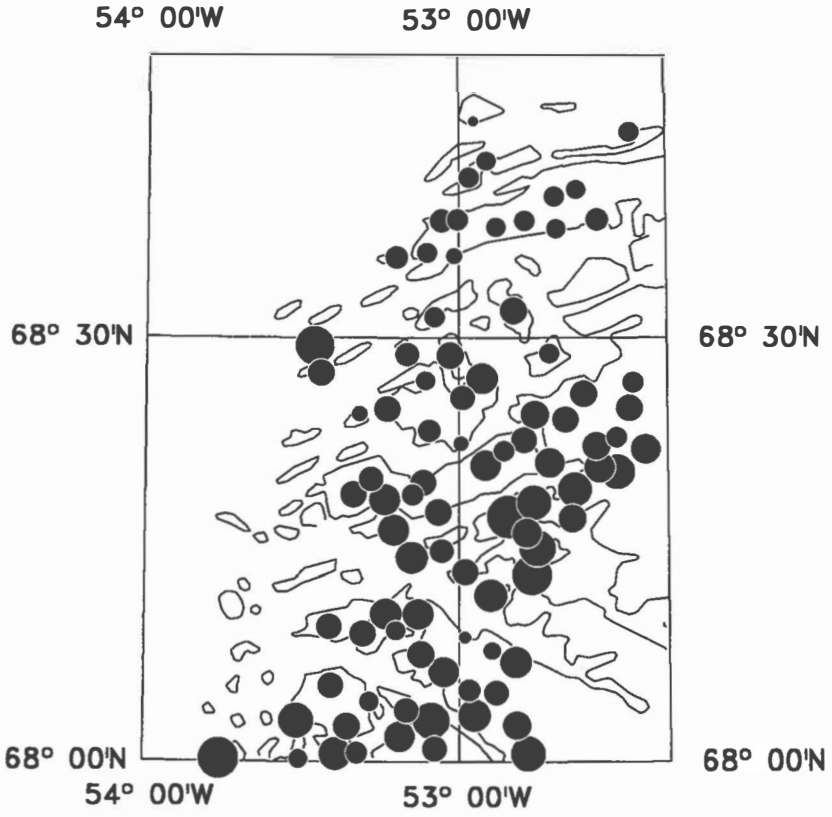
Number of samples:	88
Min. value:	1.3
Max. value:	3.6
Mean:	2.1
Median:	2.0
Variance:	0.1
Std. Dev.:	0.4

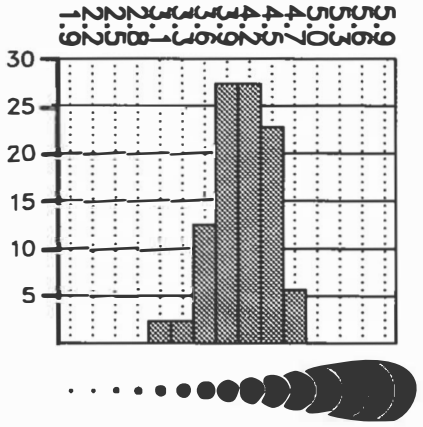
50 km

Fig. 6

Grønlands Geologiske Undersøgelse

CaO in stream sediment





CaO pct

X–ray Fluorescence

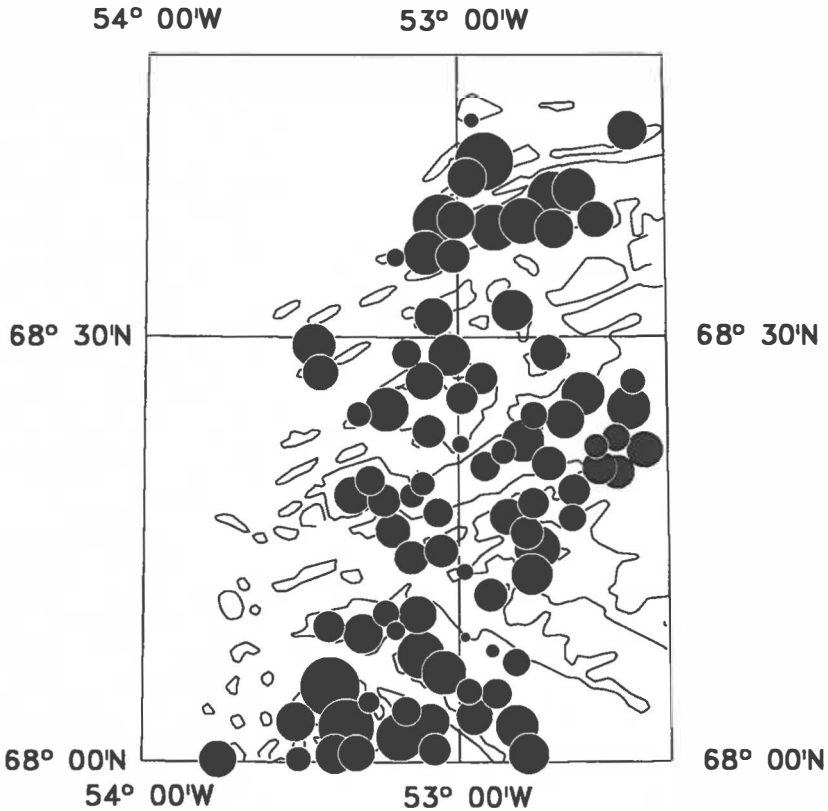
Number of samples:	88
Min. value:	3.0
Max. value:	4.8
Mean:	4.1
Median:	4.1
Variance:	0.1
Std. Dev.:	0.3

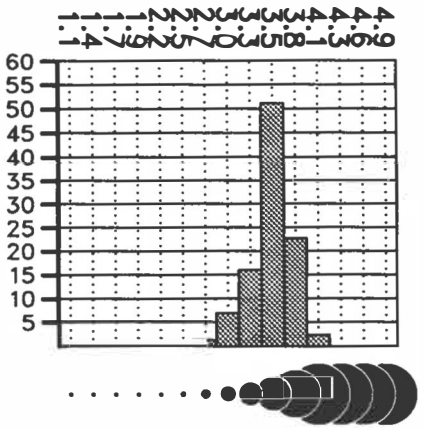
50 km

Fig. 7

Grønlands Geologiske Undersøgelse

Na_2O in stream sediment





Na_2O pct

AAS

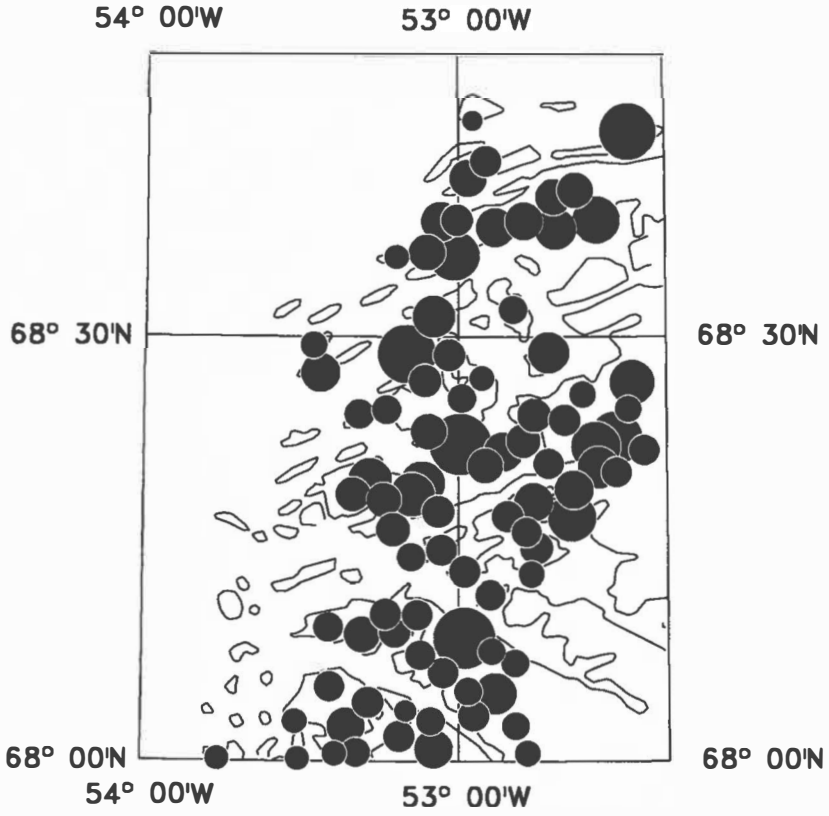
Number of samples:	88
Min. value:	2.7
Max. value:	4.0
Mean:	3.5
Median:	3.5
Variance:	0.1
Std. Dev.:	0.2

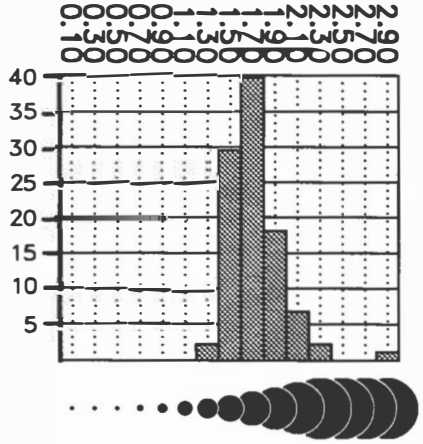
50 km

Fig. 8

Grønlands Geologiske Undersøgelse

K_2O in stream sediment





K_2O pct

X–ray Fluorescence

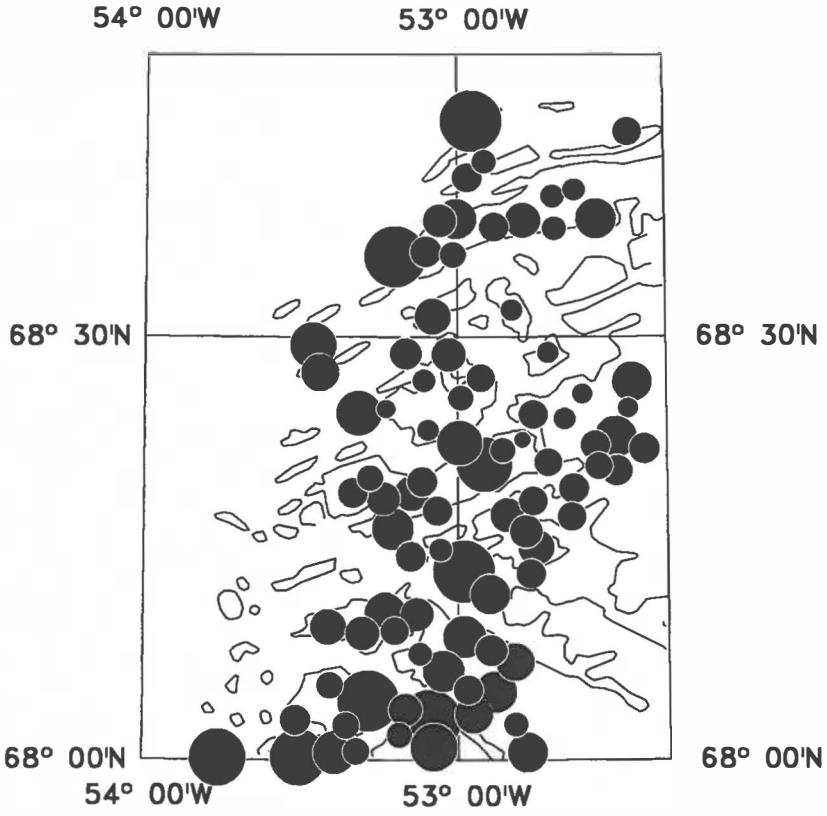
Number of samples:	88
Min. value:	1.30
Max. value:	2.96
Mean:	1.71
Median:	1.64
Variance:	0.06
Std. Dev.:	0.24

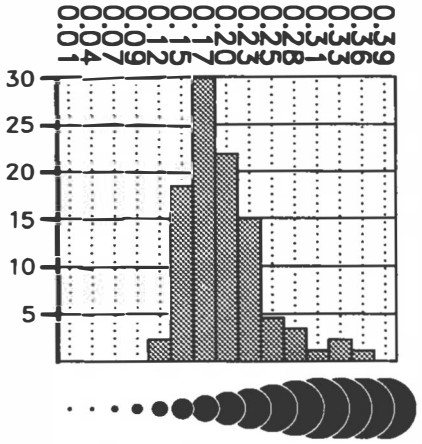
50 km

Fig. 9

Grønlands Geologiske Undersøgelse

P_2O_5 in stream sediment





P_2O_5 pct

X–ray Fluorescence

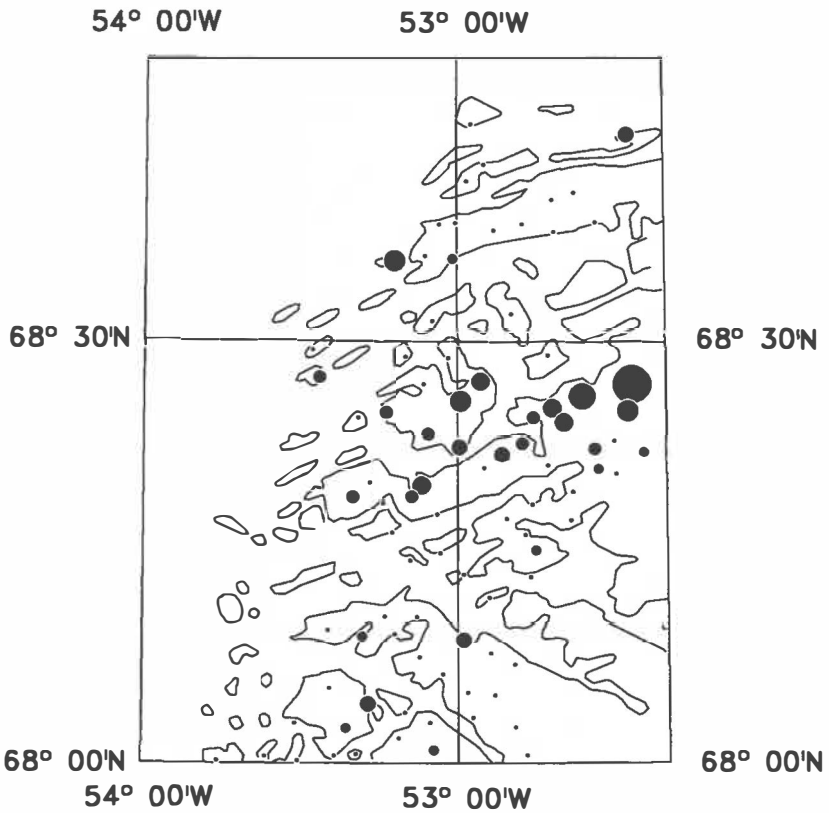
Number of samples:	88
Min. value:	0.12
Max. value:	0.47
Mean:	0.20
Median:	0.19
Variance:	0.00
Std. Dev.:	0.05

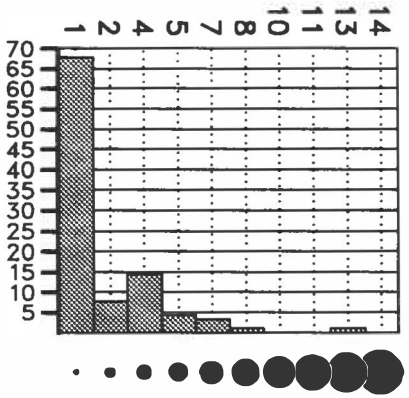
50 km

Fig. 10

Grønlands Geologiske Undersøgelse

As in stream sediment





As ppm

INAA

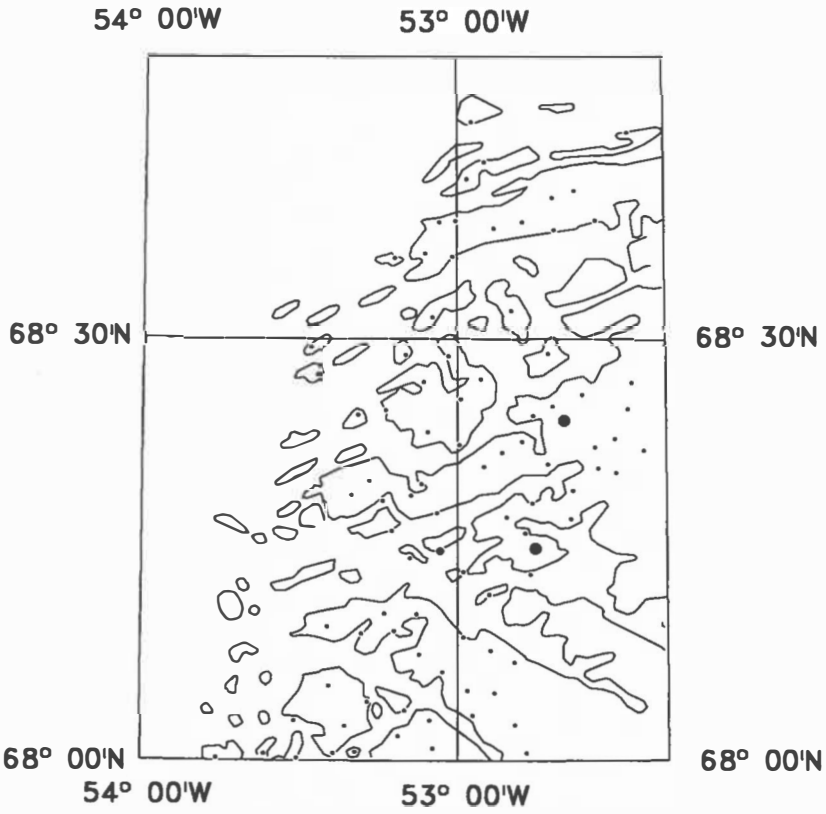
Number of samples:	90
Min. value:	0
Max. value:	12
Mean:	1
Median:	0
Variance:	5
Std. Dev.:	2

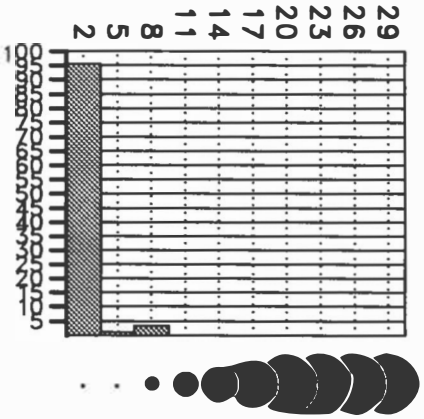
50 km

Fig. 11

Grønlands Geologiske Undersøgelse

Au in stream sediment





Au ppb

INAA

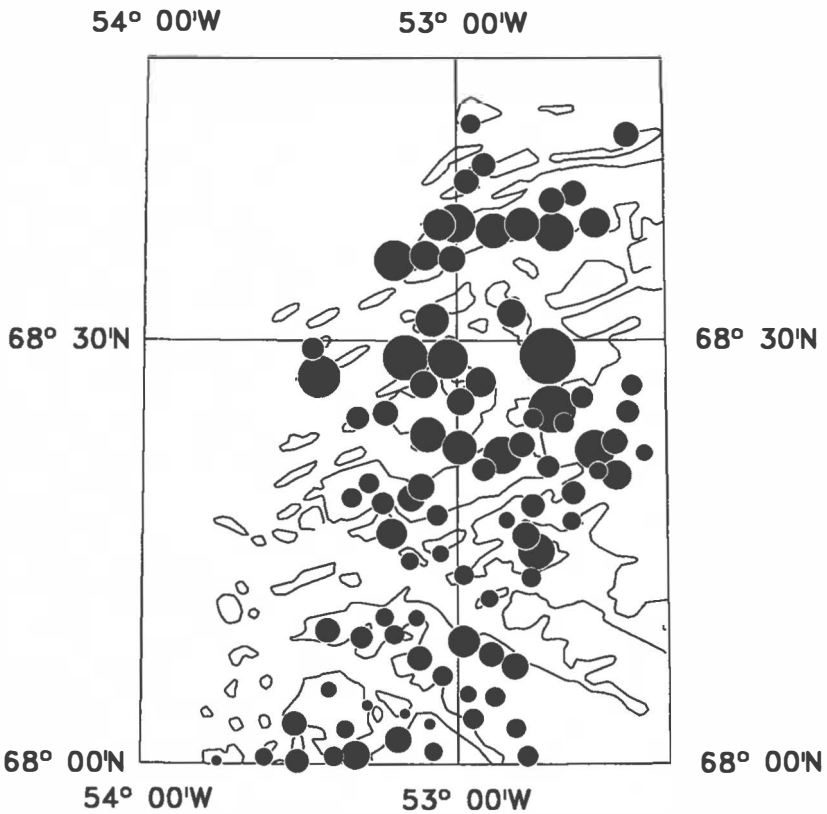
Number of samples:	90
Min. value:	0
Max. value:	7
Mean:	0
Median:	0
Variance:	2
Std. Dev.:	1

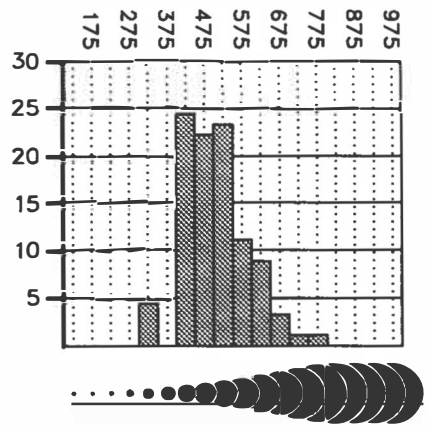
50 km

Fig. 12

Grønlands Geologiske Undersøgelse

Ba in stream sediment





Ba ppm

INAA

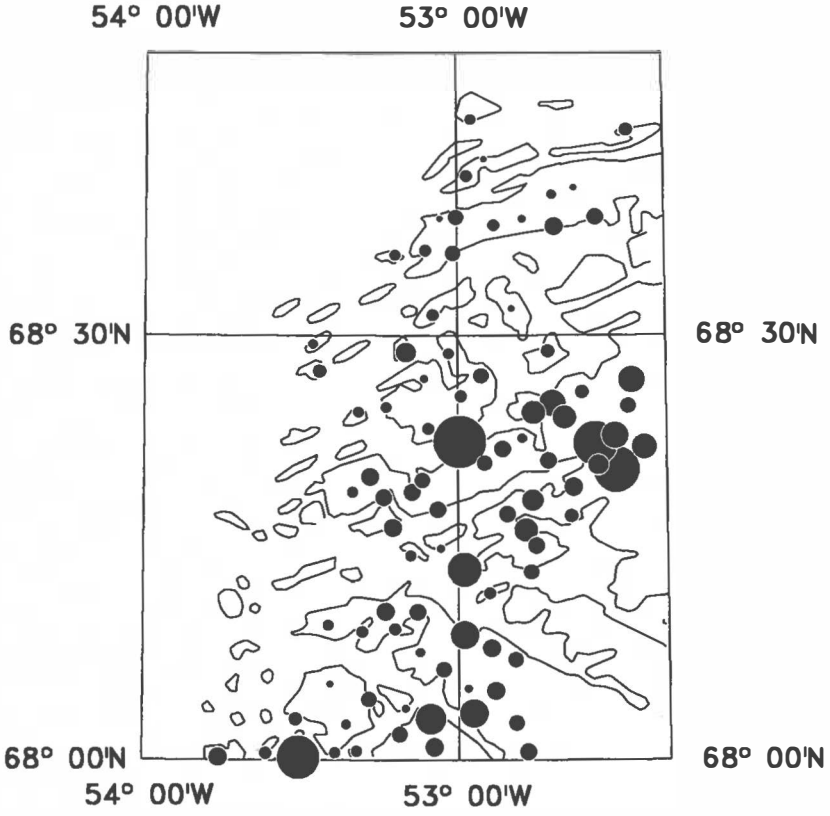
Number of samples:	90
Min. value:	320
Max. value:	760
Mean:	500
Median:	490
Variance:	7158
Std. Dev.:	85

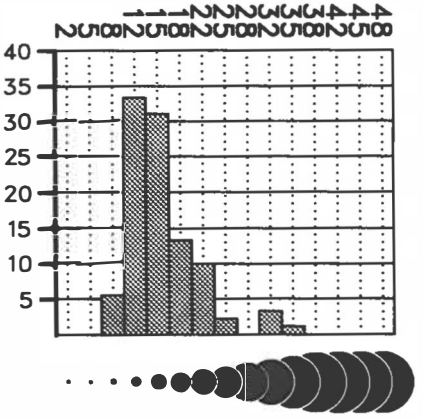
50 km

Fig. 13

Grønlands Geologiske Undersøgelse

Co in stream sediment





Co ppm

INAA

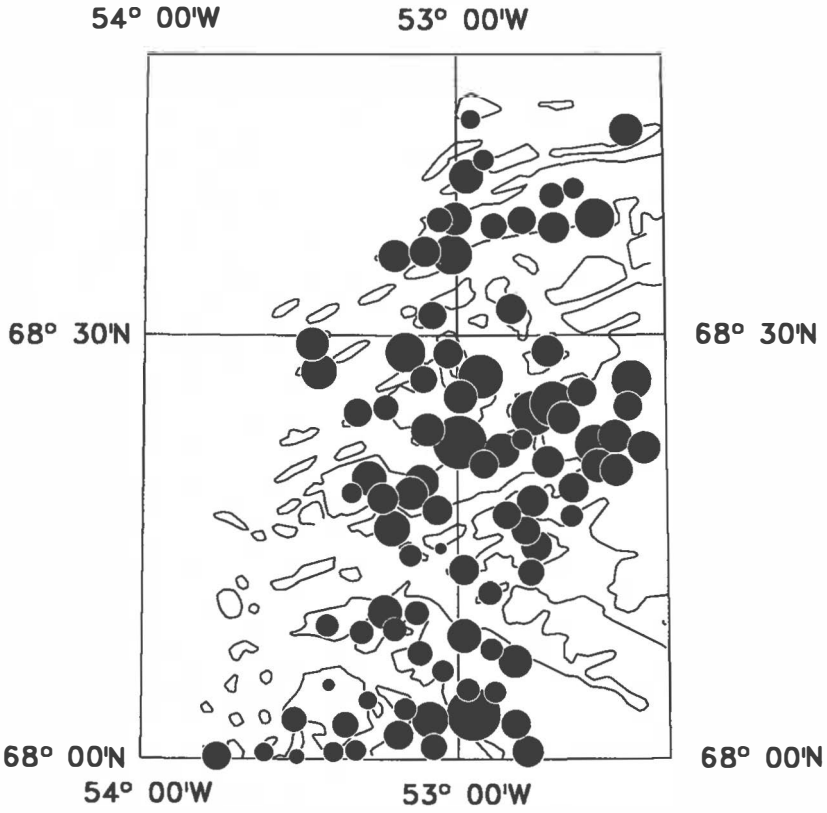
Number of samples:	90
Min. value:	8
Max. value:	35
Mean:	16
Median:	15
Variance:	26
Std. Dev.:	5

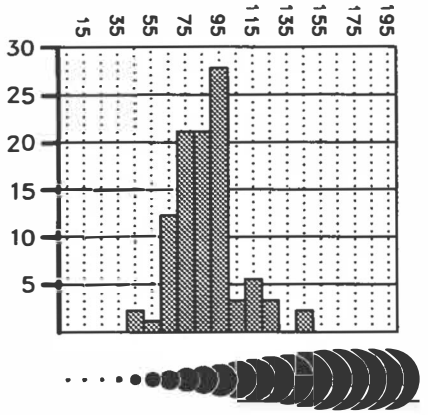
50 km

Fig. 14

Grønlands Geologiske Undersøgelse

Cr in stream sediment





Cr ppm

INAA

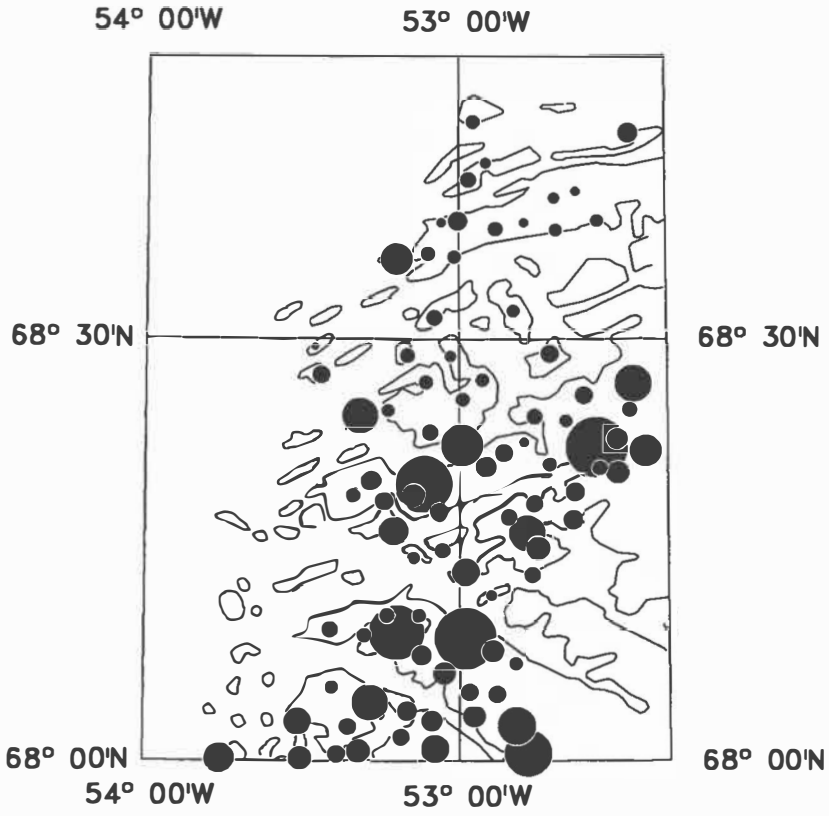
Number of samples:	90
Min. value:	47
Max. value:	140
Mean:	86
Median:	86
Variance:	293
Std. Dev.:	17

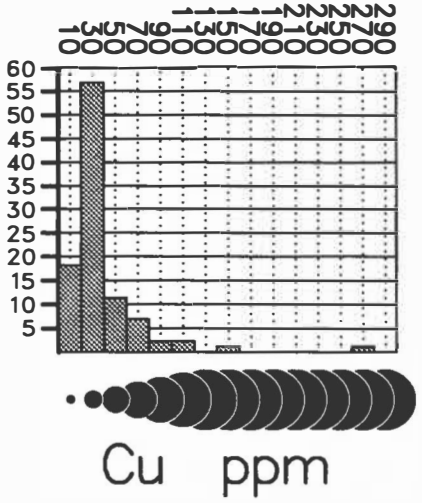
50 km

Fig. 15

Grønlands Geologiske Undersøgelse

Cu in stream sediment





Cu ppm

X–ray Fluorescence

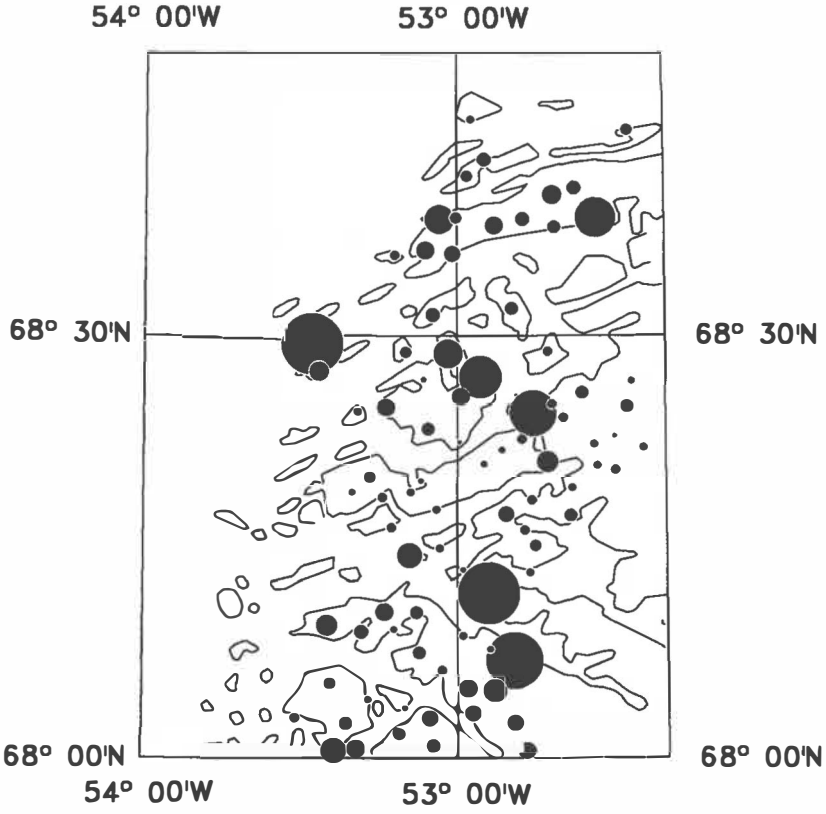
Number of samples:	88
Min. value:	7
Max. value:	275
Mean:	38
Median:	28
Variance:	1250
Std. Dev.:	35

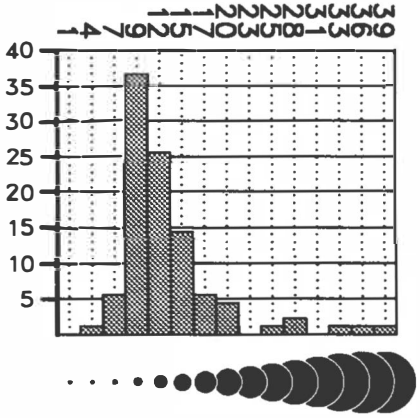
50 km

Fig. 16

Grønlands Geologiske Undersøgelse

Hf in stream sediment





Hf ppm

INAA

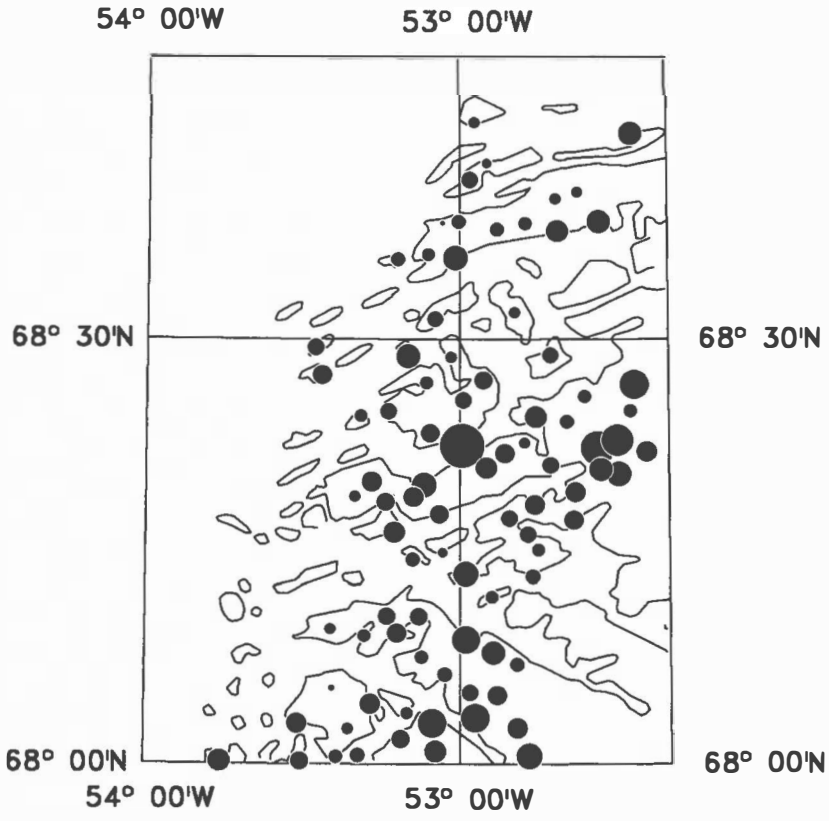
Number of samples:	90
Min. value:	4
Max. value:	38
Mean:	13
Median:	11
Variance:	37
Std. Dev.:	6

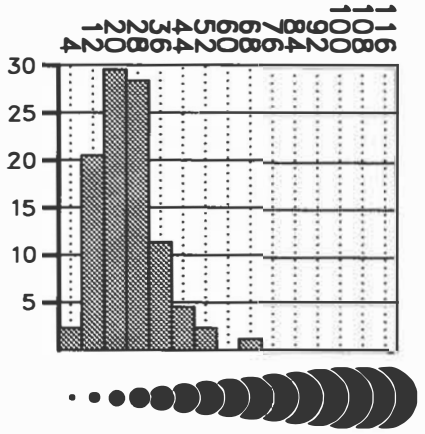
50 km

Fig. 17

Grønlands Geologiske Undersøgelse

Ni in stream sediment





Ni ppm

X–ray Fluorescence

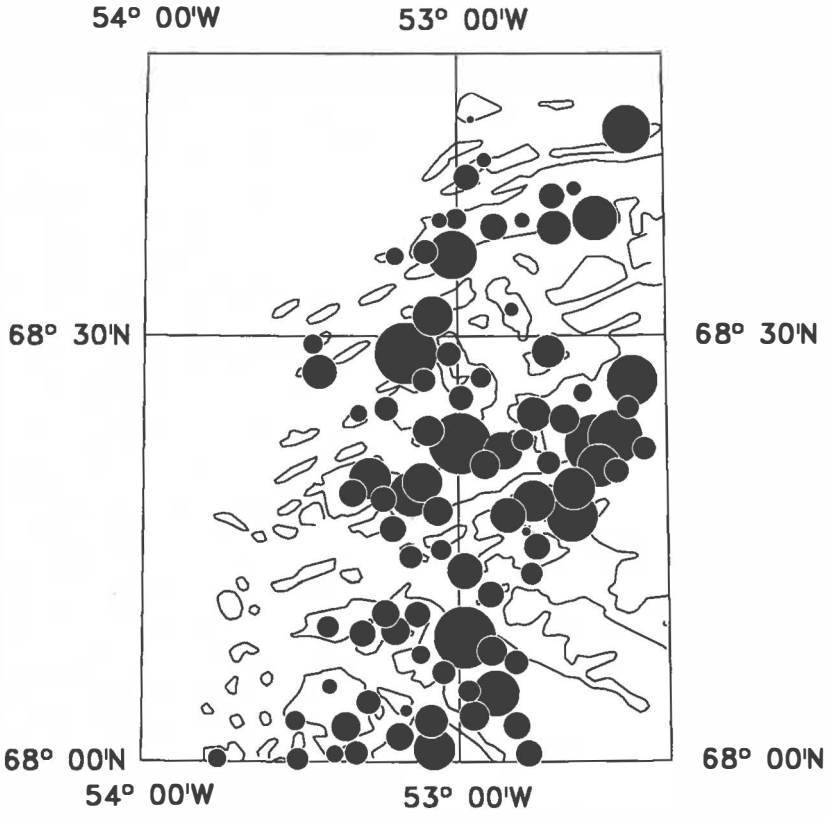
Number of samples:	88
Min. value:	1
Max. value:	69
Mean:	24
Median:	22
Variance:	116
Std. Dev.:	11

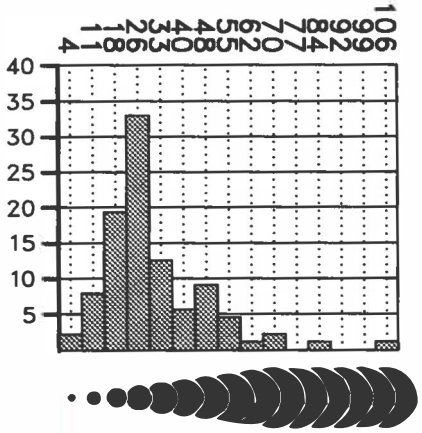
50 km

Fig. 18

Grønlands Geologiske Undersøgelse

Rb in stream sediment





Rb ppm

X–ray Fluorescence

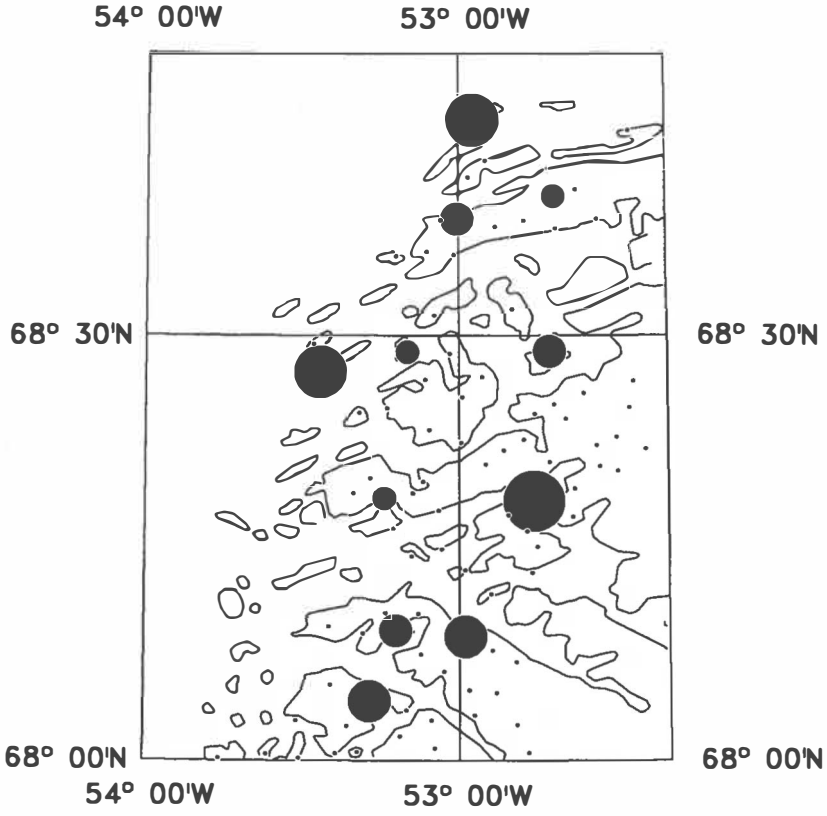
Number of samples:	88
Min. value:	3
Max. value:	104
Mean:	30
Median:	26
Variance:	288
Std. Dev.:	17

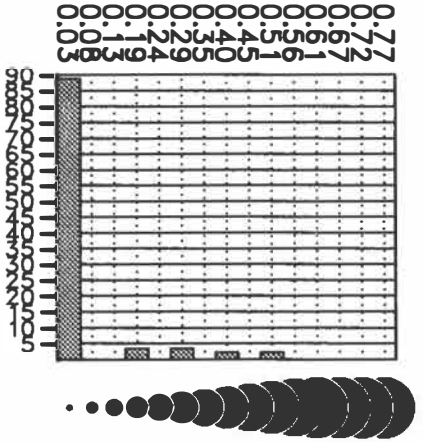
50 km

Fig. 19

Grønlands Geologiske Undersøgelse

Sb in stream sediment





Sb ppm

INAA

Number of samples:	90
Min. value:	0.00
Max. value:	0.90
Mean:	0.05
Median:	0.00
Variance:	0.02
Std. Dev.:	0.14

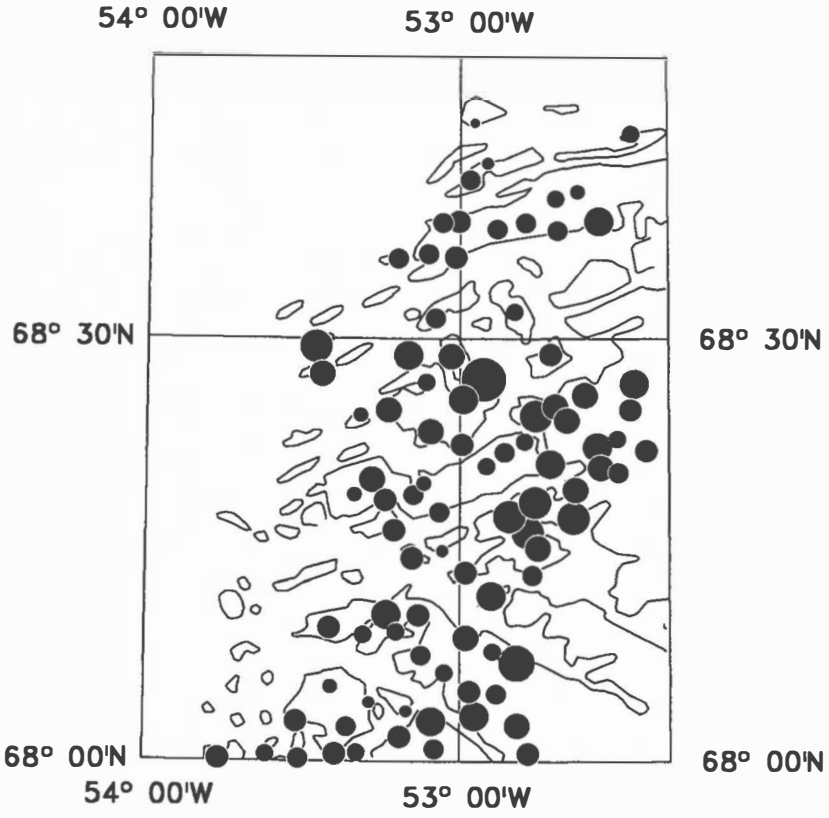
50 km

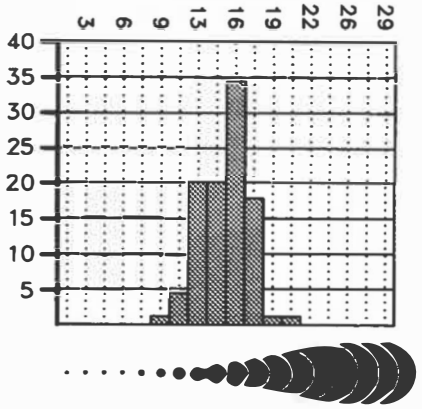
Fig. 20

Grønlands Geologiske Undersøgelse

Sc in stream sediment

Fig. 21





Sc ppm

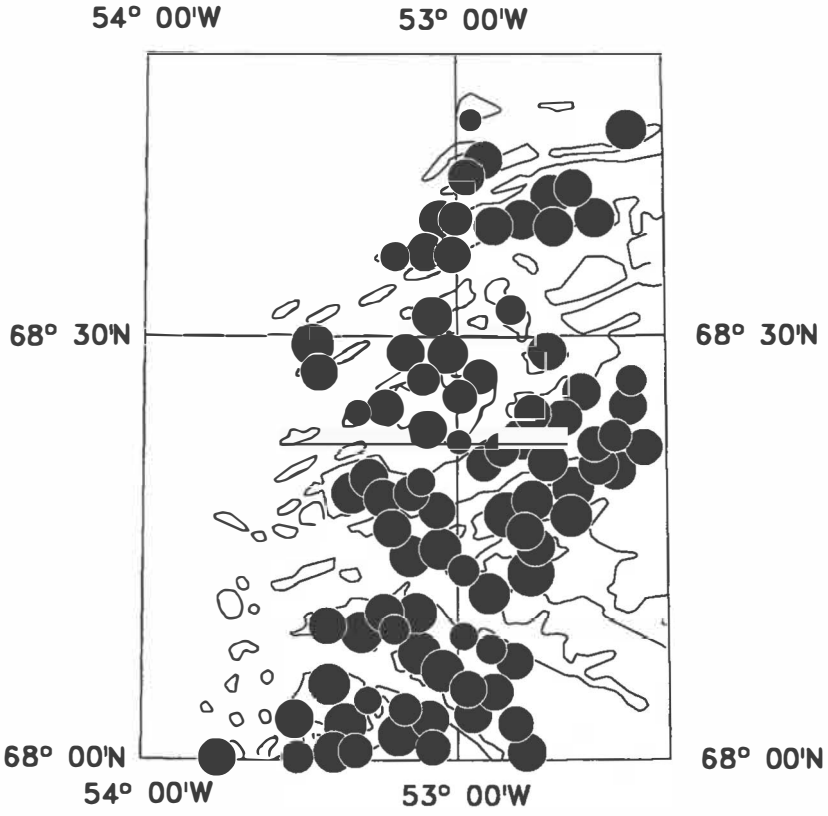
INAA

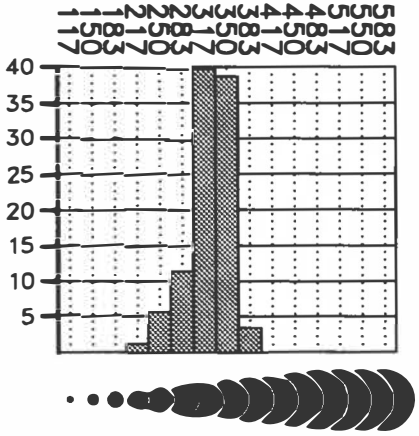
Number of samples:	90
Min. value:	10
Max. value:	21
Mean:	15
Median:	15
Variance:	4
Std. Dev.:	2

50 km

Grønlands Geologiske Undersøgelse

Sr in stream sediment





Sr ppm

X–ray Fluorescence

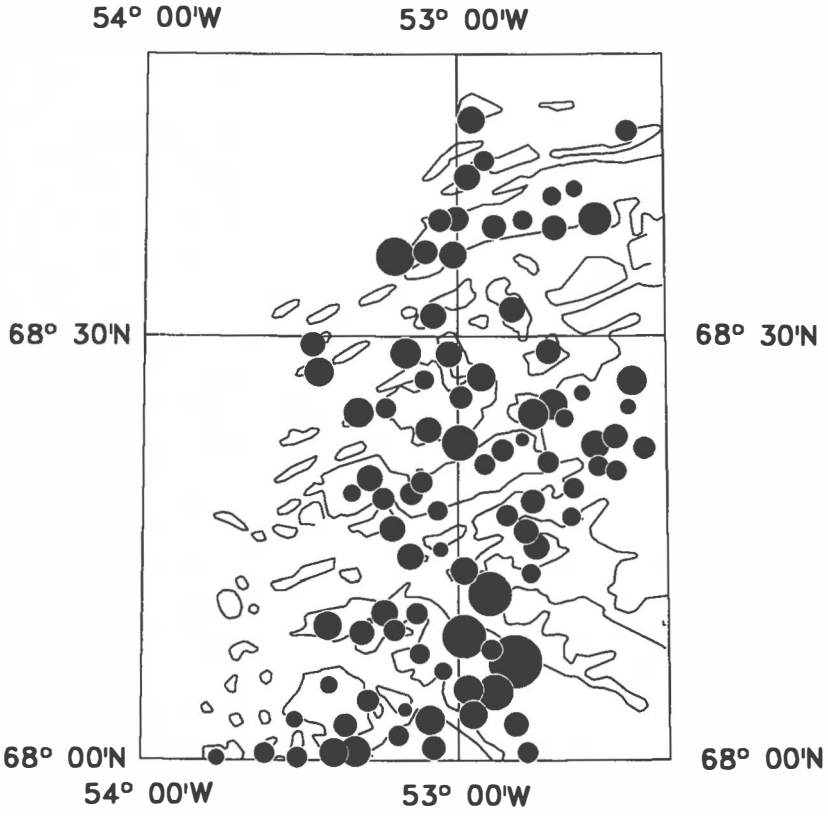
Number of samples:	88
Min. value:	222
Max. value:	392
Mean:	325
Median:	330
Variance:	1032
Std. Dev.:	32

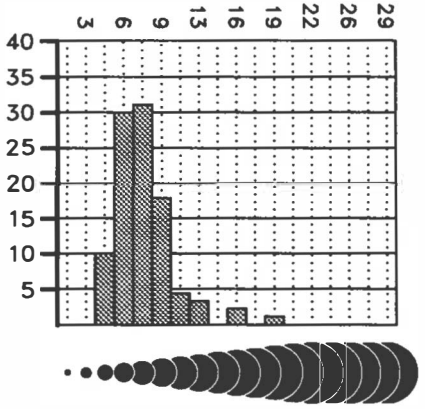
50 km

Fig. 22

Grønlands Geologiske Undersøgelse

Th in stream sediment





Th ppm

INAA

Number of samples:	90
Min. value:	4
Max. value:	19
Mean:	8
Median:	7
Variance:	6
Std. Dev.:	3

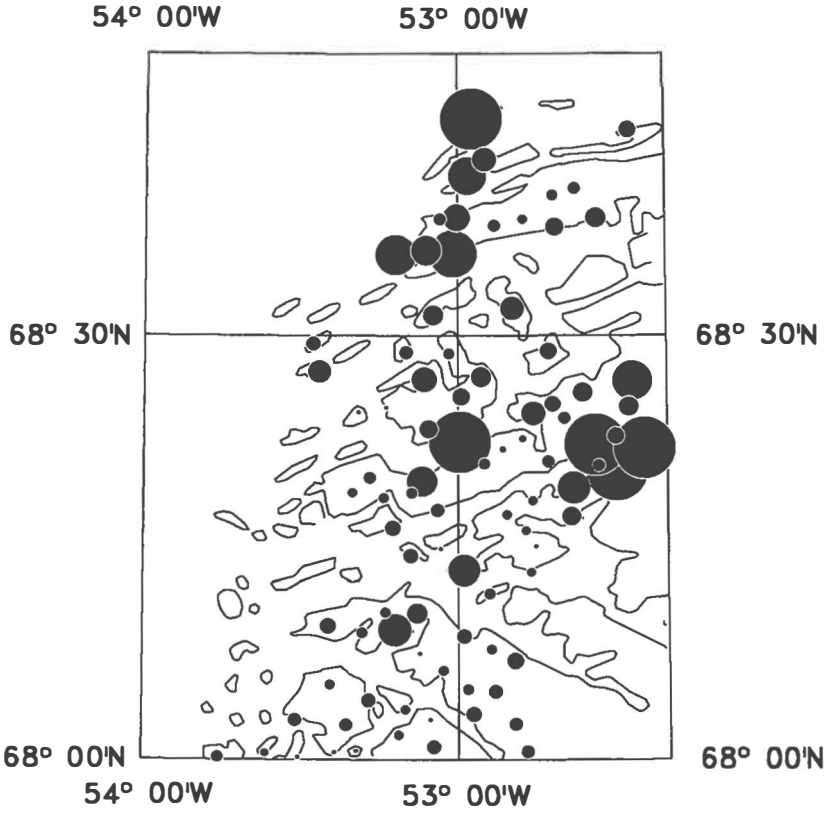
50 km

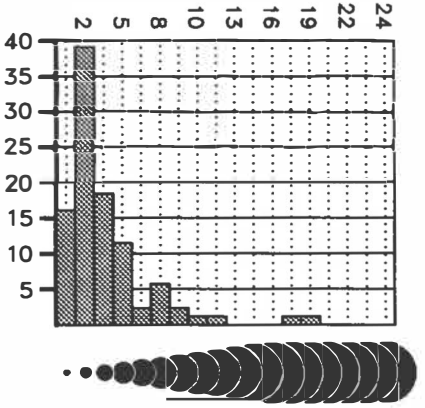
Fig. 23

Grønlands Geologiske Undersøgelse

U in stream sediment

Fig. 24





U ppm

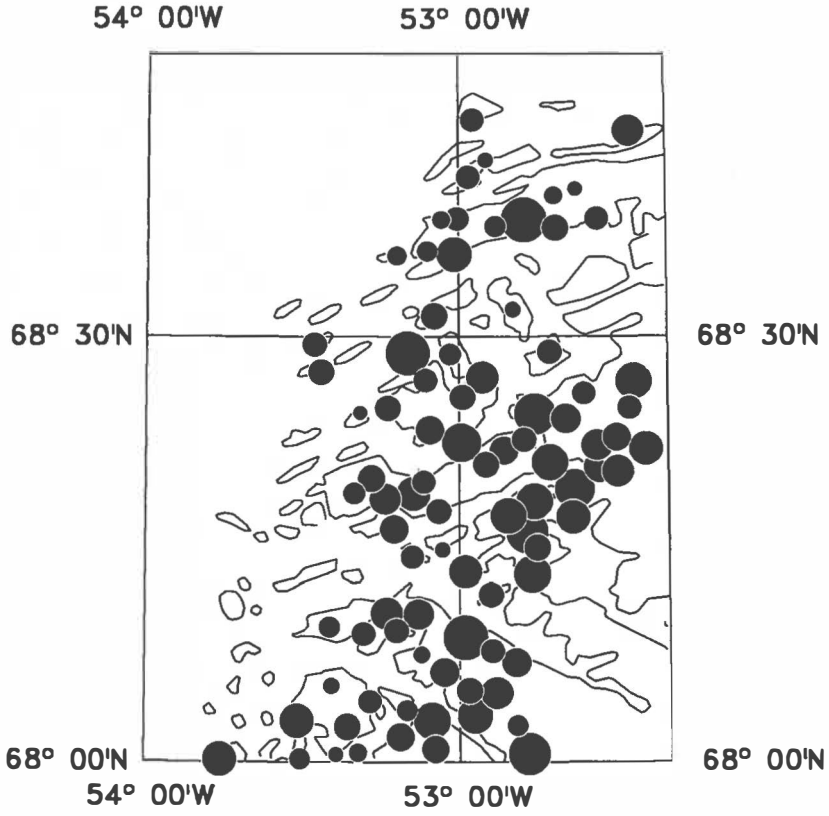
INAA

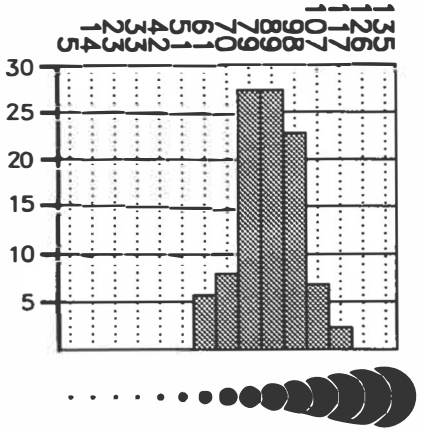
Number of samples:	90
Min. value:	0
Max. value:	42
Mean:	5
Median:	3
Variance:	48
Std. Dev.:	7

50 km

Grønlands Geologiske Undersøgelse

V in stream sediment





V ppm

X–ray Fluorescence

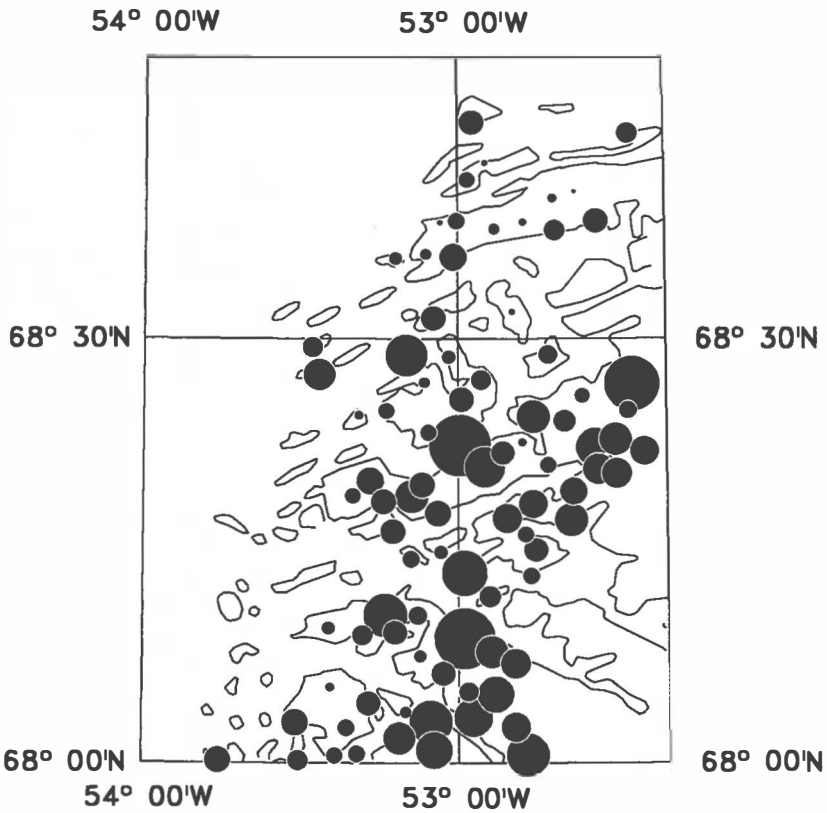
Number of samples:	88
Min. value:	62
Max. value:	113
Mean:	87
Median:	86
Variance:	145
Std. Dev.:	12

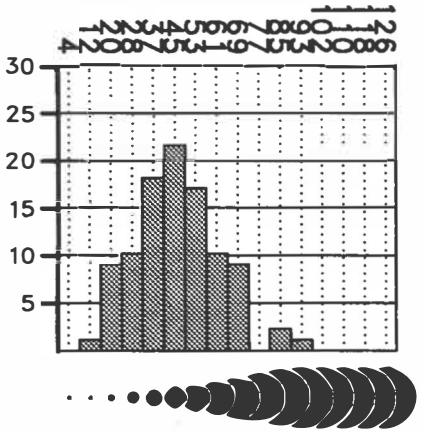
50 km

Fig. 25

Grønlands Geologiske Undersøgelse

Zn in stream sediment





Zn ppm

X–ray Fluorescence

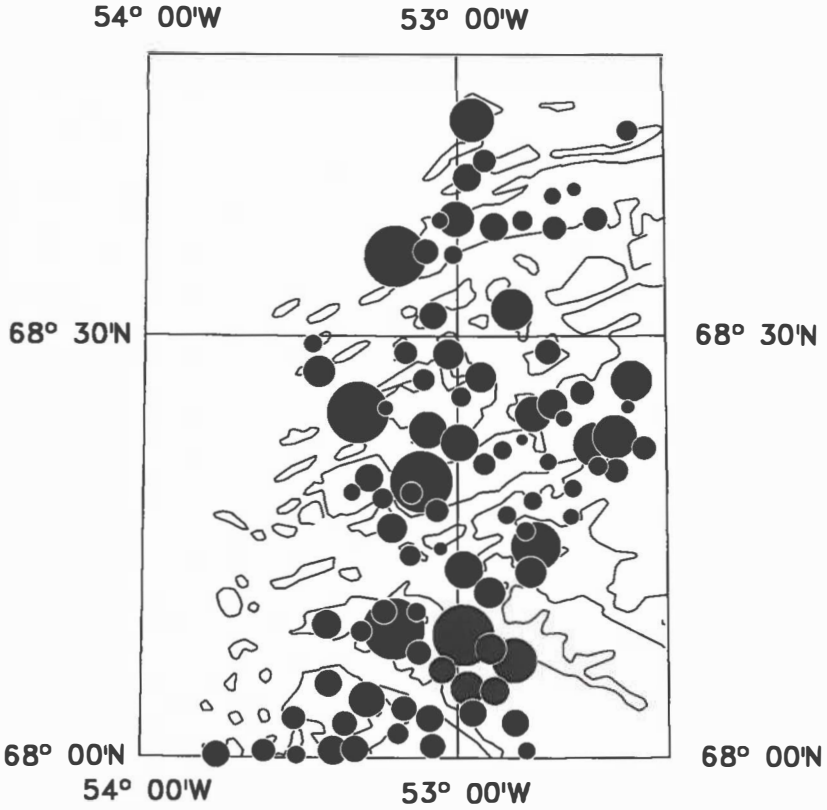
Number of samples:	88
Min. value:	14
Max. value:	96
Mean:	46
Median:	46
Variance:	254
Std. Dev.:	16

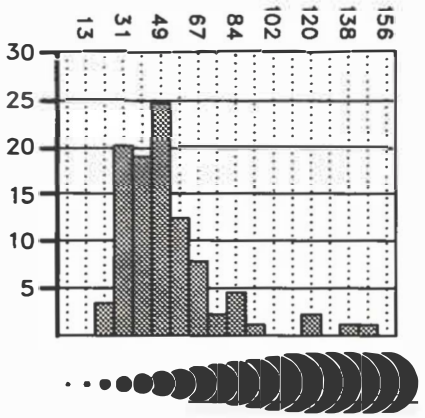
50 km

Fig. 26

Grønlands Geologiske Undersøgelse

La in stream sediment





La ppm

INAA

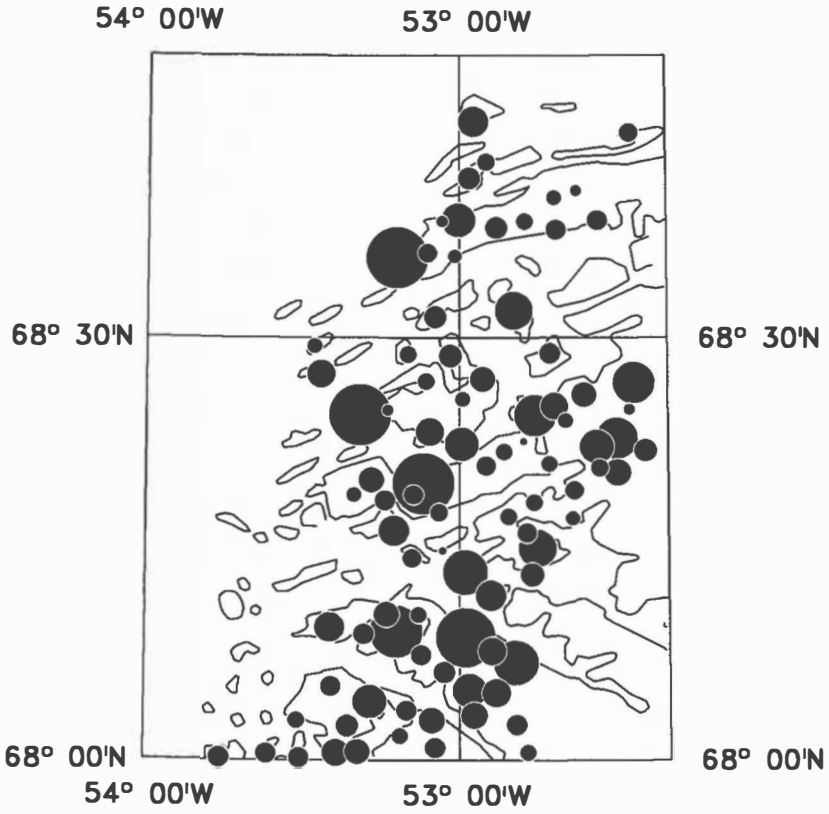
Number of samples:	90
Min. value:	22
Max. value:	160
Mean:	53
Median:	47
Variance:	651
Std. Dev.:	26

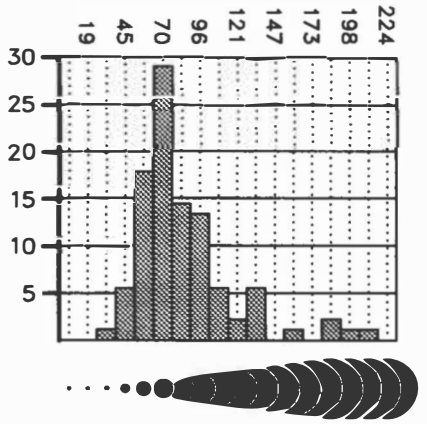
50 km

Fig. 27

Grønlands Geologiske Undersøgelse

Ce in stream sediment





Ce ppm

INAA

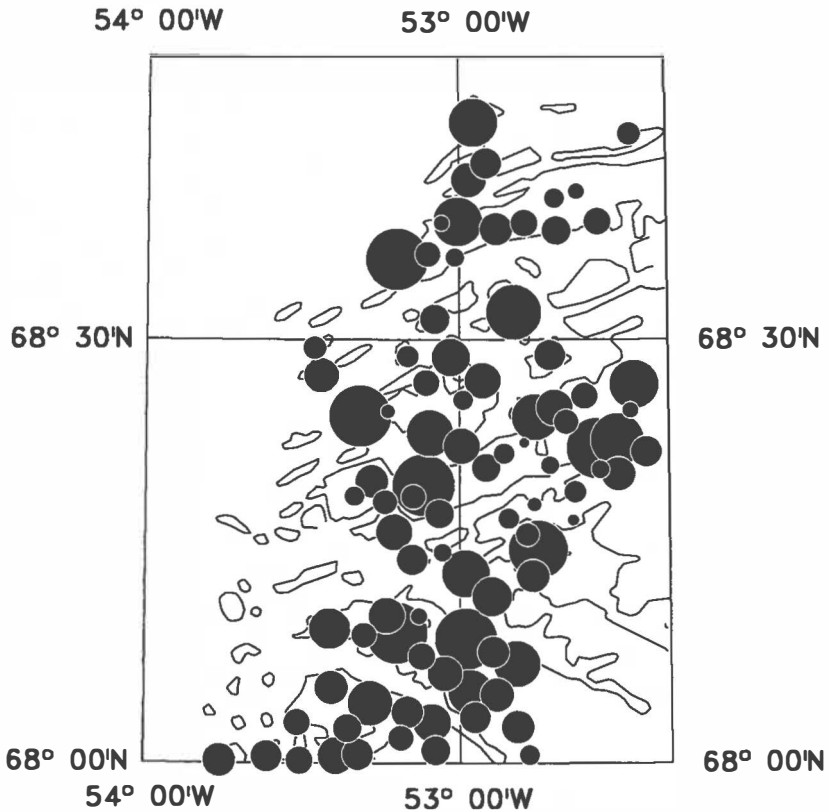
Number of samples:	90
Min. value:	37
Max. value:	210
Mean:	85
Median:	74
Variance:	1113
Std. Dev.:	33

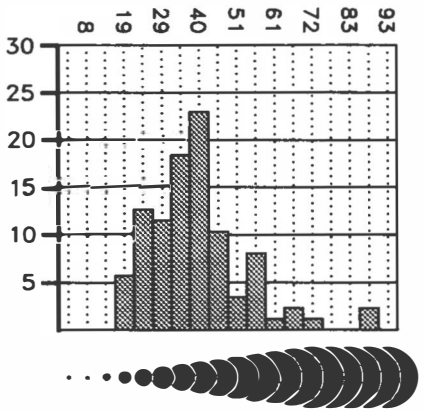
50 km

Fig. 28

Grønlands Geologiske Undersøgelse

Nd in stream sediment





Nd ppm

INAA

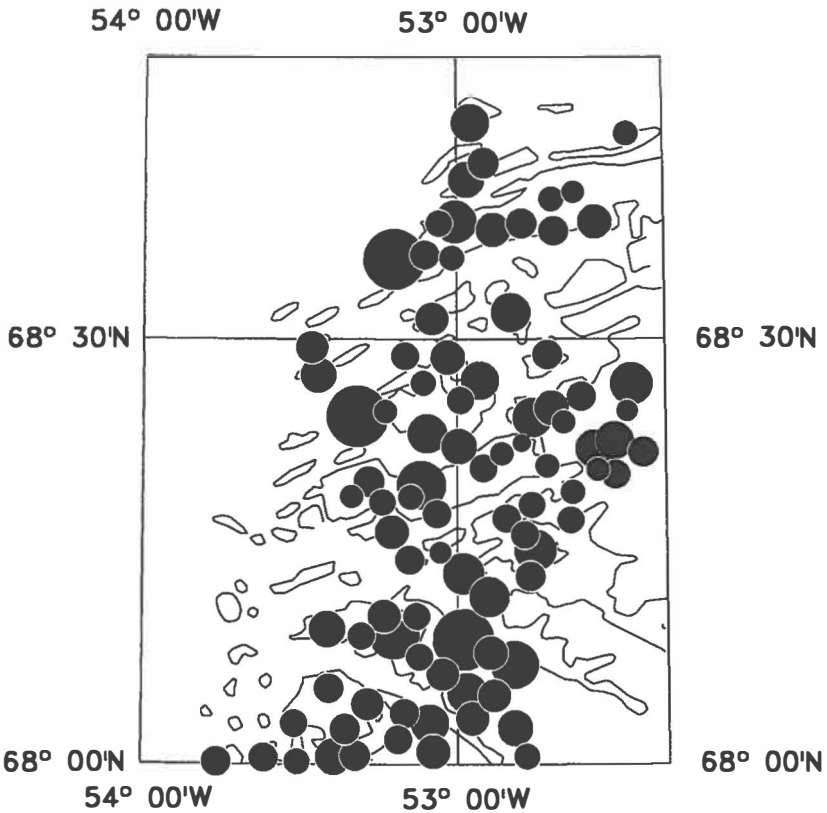
Number of samples:	90
Min. value:	16
Max. value:	140
Mean:	41
Median:	38
Variance:	390
Std. Dev.:	20

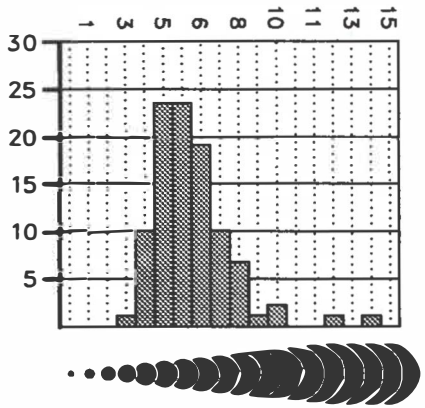
50 km

Fig. 29

Grønlands Geologiske Undersøgelse

Sm in stream sediment





Sm ppm

INAA

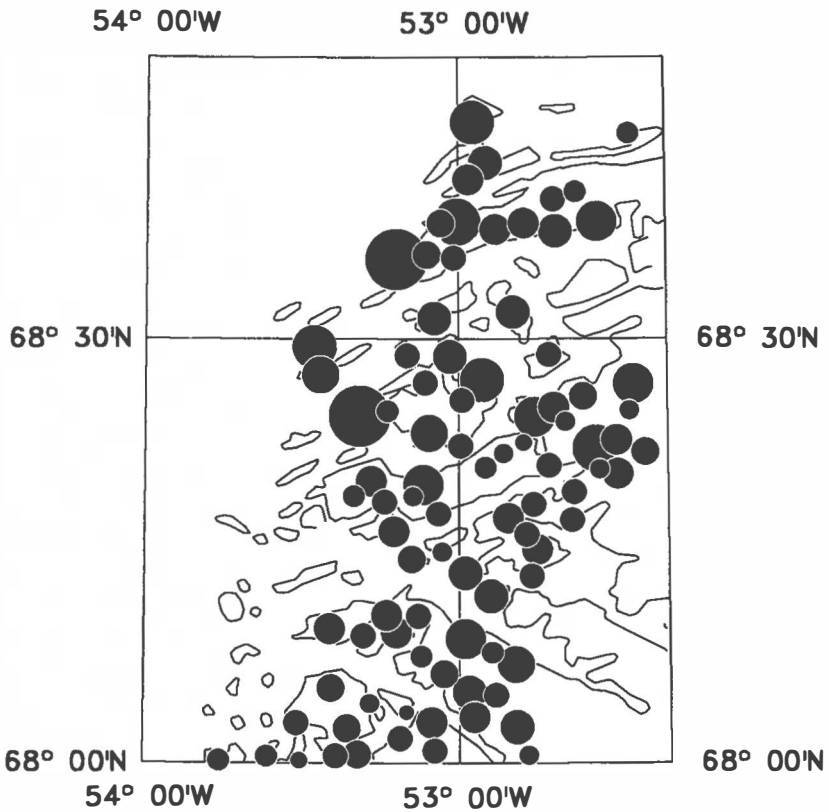
Number of samples:	90
Min. value:	3
Max. value:	16
Mean:	6
Median:	5
Variance:	4
Std. Dev.:	2

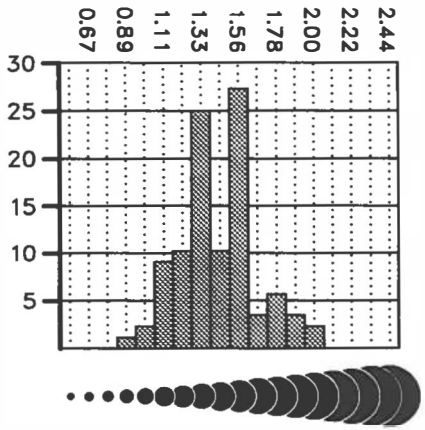
50 km

Fig. 30

Grønlands Geologiske Undersøgelse

Eu in stream sediment





Eu ppm

INAA

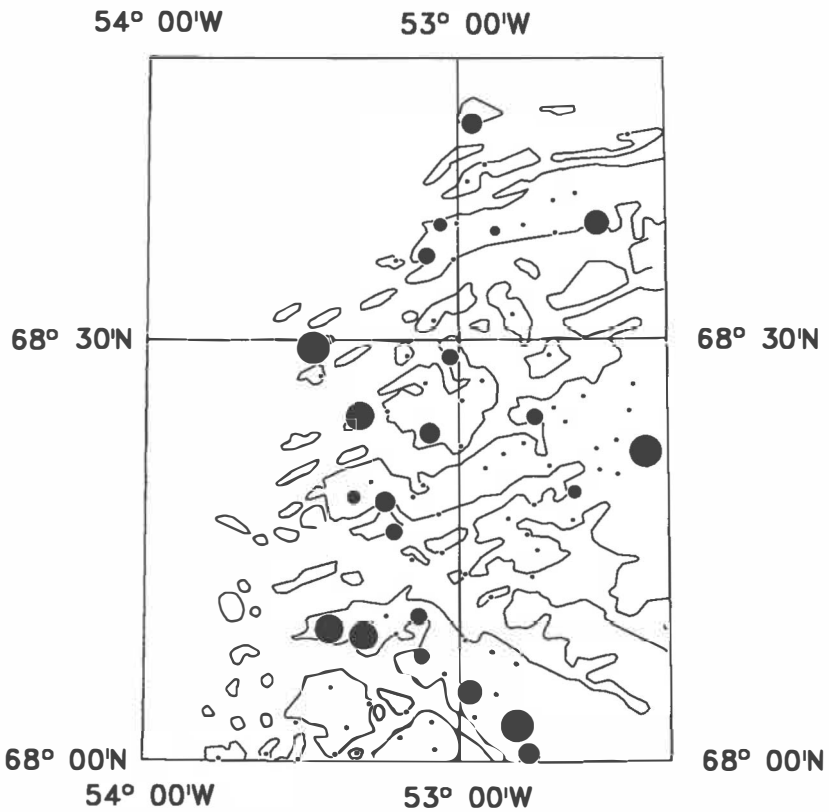
Number of samples:	90
Min. value:	0.90
Max. value:	3.50
Mean:	1.45
Median:	1.40
Variance:	0.12
Std. Dev.:	0.35

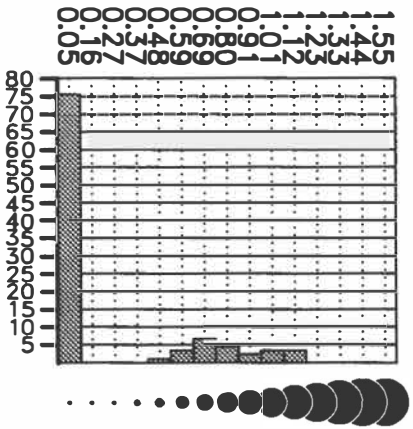
50 km

Fig. 31

Grønlands Geologiske Undersøgelse

Tb in stream sediment





Tb ppm

INAA

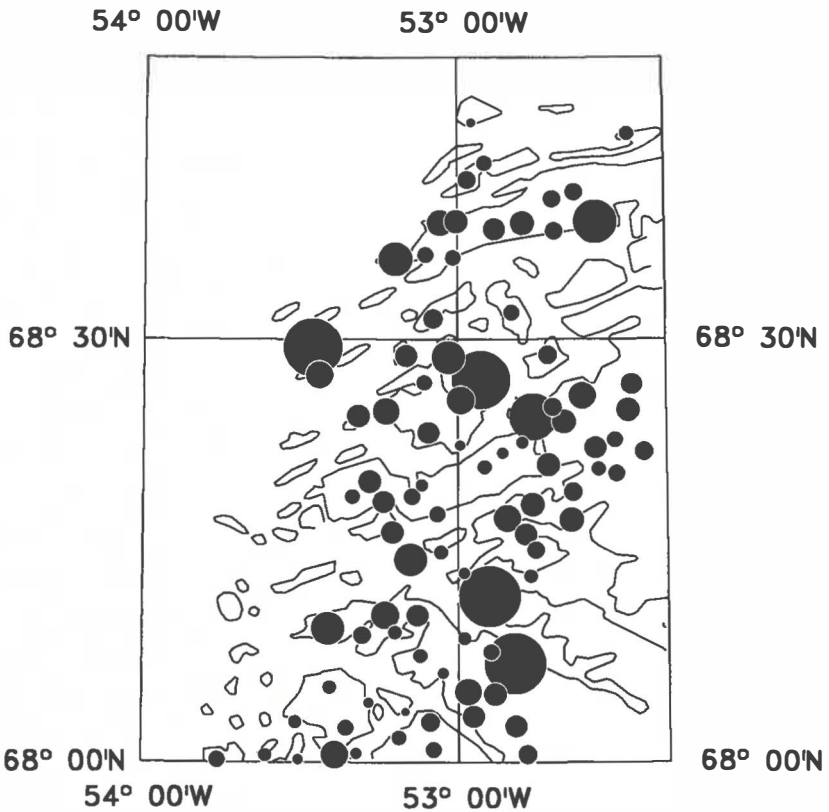
Number of samples:	90
Min. value:	0.00
Max. value:	1.10
Mean:	0.20
Median:	0.00
Variance:	0.13
Std. Dev.:	0.36

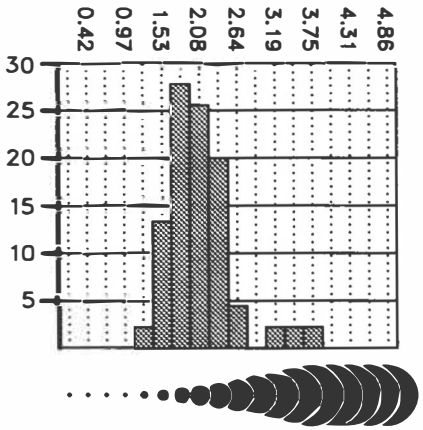
50 km

Fig. 32

Grønlands Geologiske Undersøgelse

Yb in stream sediment





Yb ppm

INAA

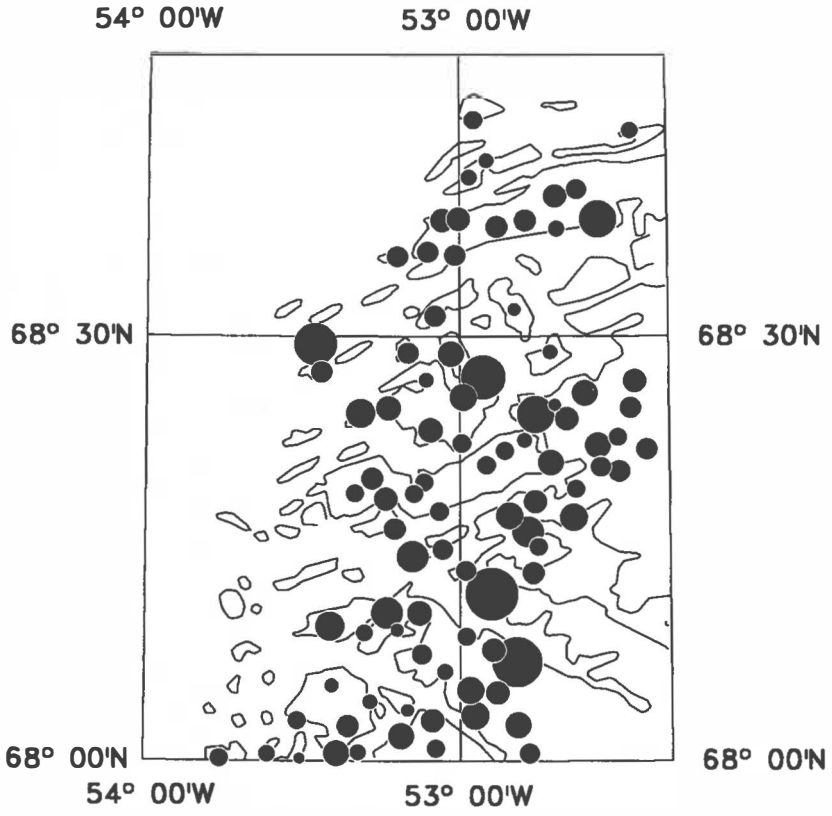
Number of samples:	90
Min. value:	1.34
Max. value:	3.87
Mean:	2.10
Median:	2.00
Variance:	0.25
Std. Dev.:	0.50

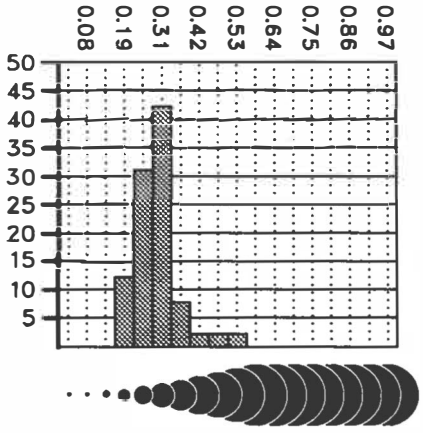
50 km

Fig. 33

Grønlands Geologiske Undersøgelse

Lu in stream sediment





Lu ppm

INAA

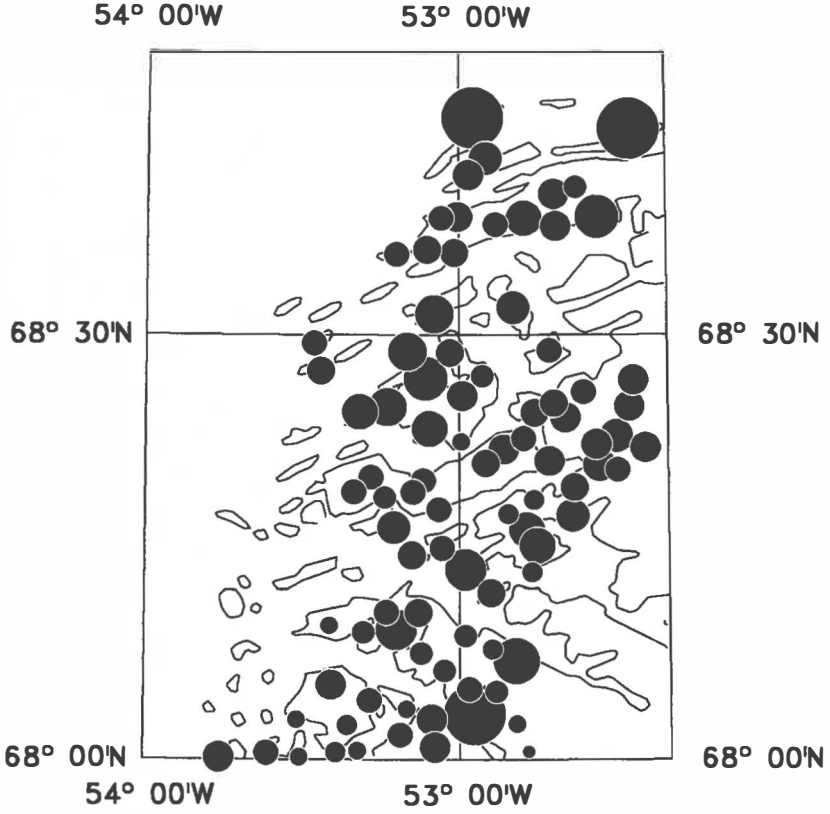
Number of samples:	90
Min. value:	0.18
Max. value:	0.52
Mean:	0.29
Median:	0.28
Variance:	0.00
Std. Dev.:	0.06

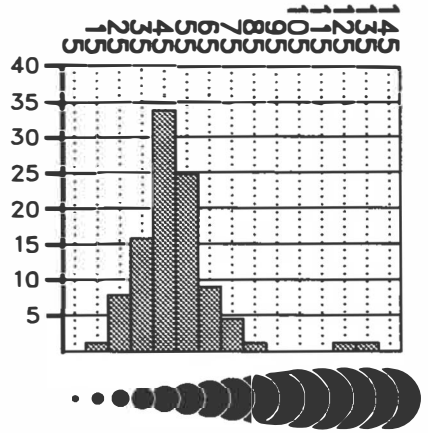
50 km

Fig. 34

Grønlands Geologiske Undersøgelse

Total radiation





Counts per sec.

Scintillometry

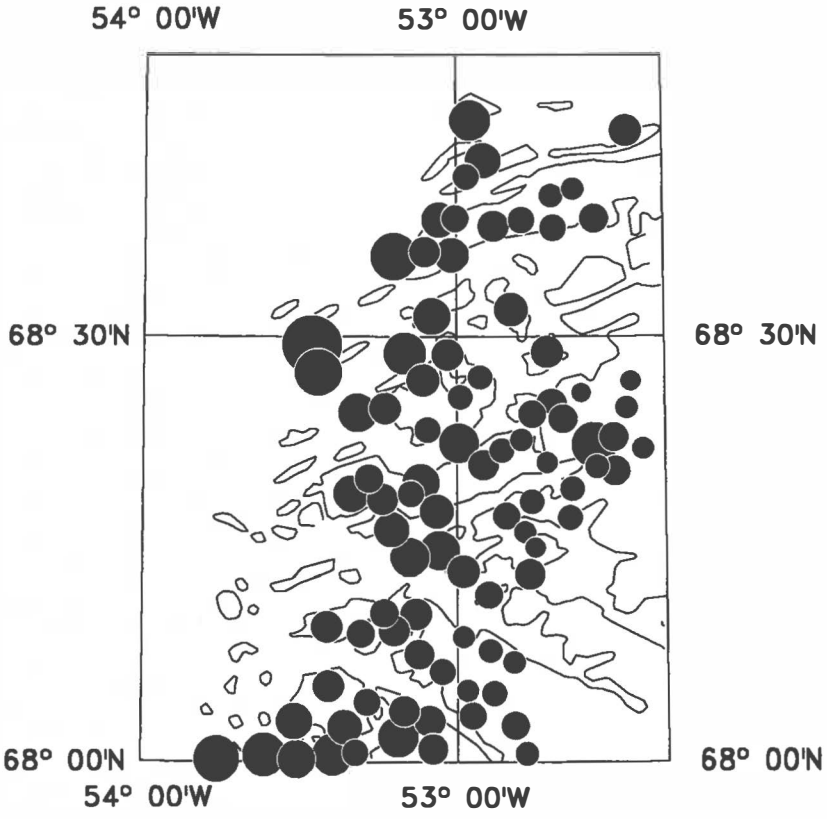
Number of samples:	90
Min. value:	15
Max. value:	150
Mean:	48
Median:	45
Variance:	417
Std. Dev.:	20

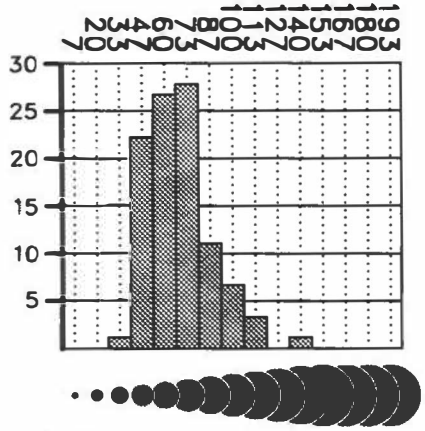
50 km

Fig. 35

Grønlands Geologiske Undersøgelse

Conductivity of stream water





Micro Sievert

Number of samples:	90
Min. value:	40
Max. value:	144
Mean:	69
Median:	66
Variance:	355
Std. Dev.:	19

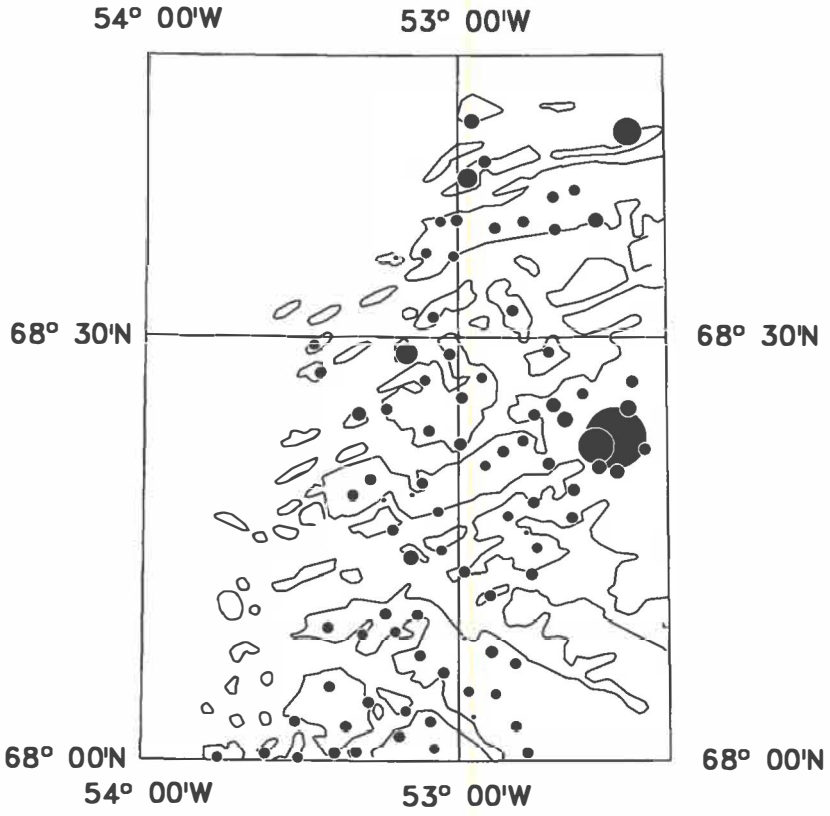
50 km

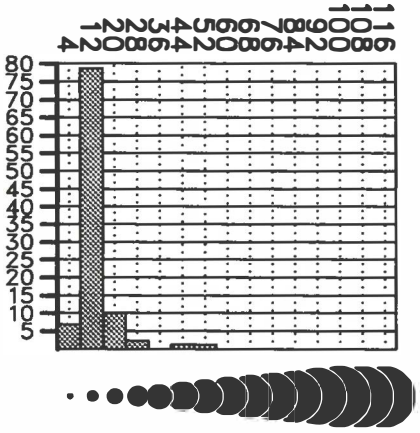
Fig. 36

Grønlands Geologiske Undersøgelse

F in stream water

Fig. 37





F ppb

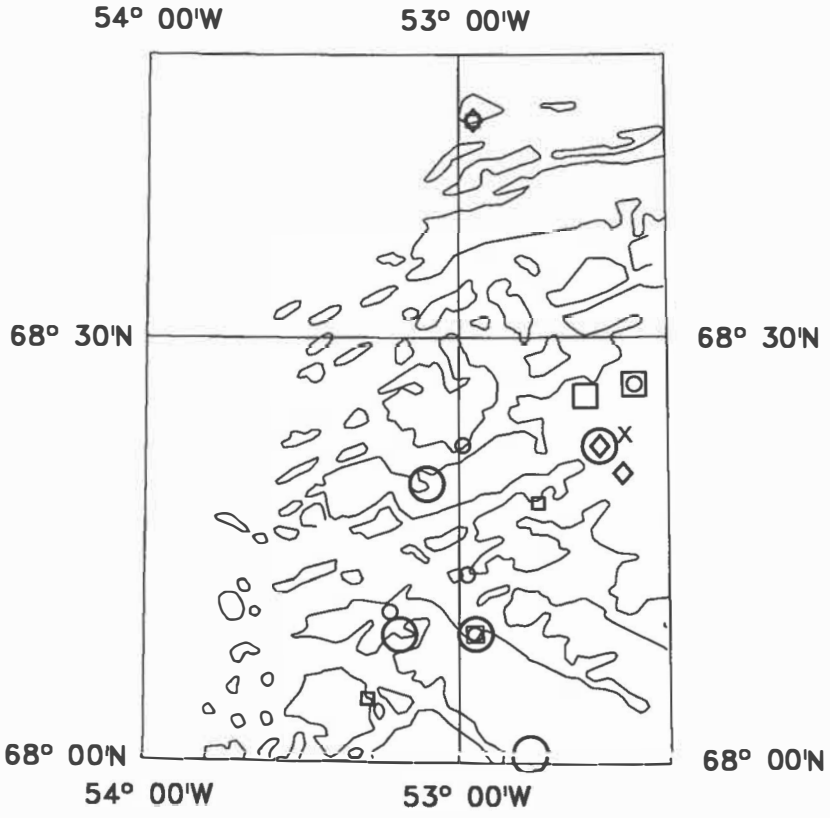
Ion sensitive electrode

Number of samples:	90
Min. value:	0
Max. value:	120
Mean:	14
Median:	11
Variance:	177
Std. Dev.:	13

50 km

Grønlands Geologiske Undersøgelse

Geochemical anomalies



□	As	>	8 ppm
▫	Sb	>	0.3 ppm
◯	Cu	>	90 ppm
○	Zn	>	70 ppm
◇	U	>	20 ppm
x	F	>	60 ppb

50 km

Fig. 38

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