Northwest Atlantic Fisheries Organization

Serial No. N1354

NAFO SCR Doc. 87/65

SCIENTIFIC COUNCIL MEETING - JUNE 1987

Temperature and Salinity Anomalies of the Northwest Atlantic in 1986

by

J. R. Keeley

Marine Environmental Data Service (MEDS), 200 Kent Street
Ottawa, Ontario, Canada K1A 0E6

Introduction

In 1985, Keeley generated anomaly maps of anomalies of temperature and salinity for the Northwest Atlantic. There were displays of these at depths of 0, 100, 250, and 500 m. The anomalies were calculated using all of the data available from the previous year and using the Levitus atlas, 1982, as the climatology. The atlas contained seasonal analyses of these two properties, among others. Since that time, Levitus has published other atlases, one being monthly values of the temperature at depths down to 1000 m. The displays here show an analysis of the temperature anomalies by month and at the same four depths as was done before. Included for comparison are the seasonal displays.

Data Analysis

This short note will not describe in detail the process whereby the anomalies were generated. If more detail is needed, readers should consult Keeley, 1985 or Keeley, 1987. A brief summary is given here of the technique employed.

This technique of optimum interpolation makes use of the spatial covariance function characterizing the data. A main requirement is that the data be stationary, which the temperature field is not. However, the anomalies will be if the scale of the analysis is much larger than the scales of the anomalies.

The first step was to calculate the anomalies of the temperature. This was done by using bi-linear interpolation of the atlas values surrounding each observation to arrive at the mean value at the observation point. This process was followed for all data surrounded by atlas values at each of the four corners of the latitude and longitude grid. After interpolations in space were completed, an interpolation in time was needed. An examination of the annual variation of the temperature in the Levitus atlas at a variety of locations was done. It showed that the variation was smooth and could be adequately represented in most locations be a linear fit between monthly values. Given this, the interpolations in both space and time were done, and the resulting mean value subtracted from the observation in order to derive the anomaly value.

The next stage was the determination of the spatial covariance function of the anomalies. Keeley (1985) used as much data as he could find for the entire North Atlantic since the more data available, the more stable would be the results. These were used to fit to a covariance of the form

$$C(r) = (V-E)\exp[-.5(r/Rs)^{P}]$$

where the four parameters V, E, Rs, P need to be estimated. V is the variance in the field including noise, E is the variance of the noise of the data, Rs is a correlation scale length and P is an exponent. r is the

separation distance. After detailed analyses, he arrived at values of 5.11, 1.37, 150 and 2.0 were used for the four parameters, V, E, Rs and P respectively.

The results of the analyses of the temperature data are shown in the figures attached. There are 4 for each month of 1986, one at each of the four depths. As before, temperature anomalies have been contoured. Regions of positive anomalies are shaded by vertical dashed lines and regions of negative anomalies shaded by horizontal solid lines. Regions of heavier shading correspond to those where the error is less than plus or minus 1 degree C. Lighter shaded regions have errors between plus and minus 1 and plus and minus 2.5 degrees C. Regions with larger errors have been blanked.

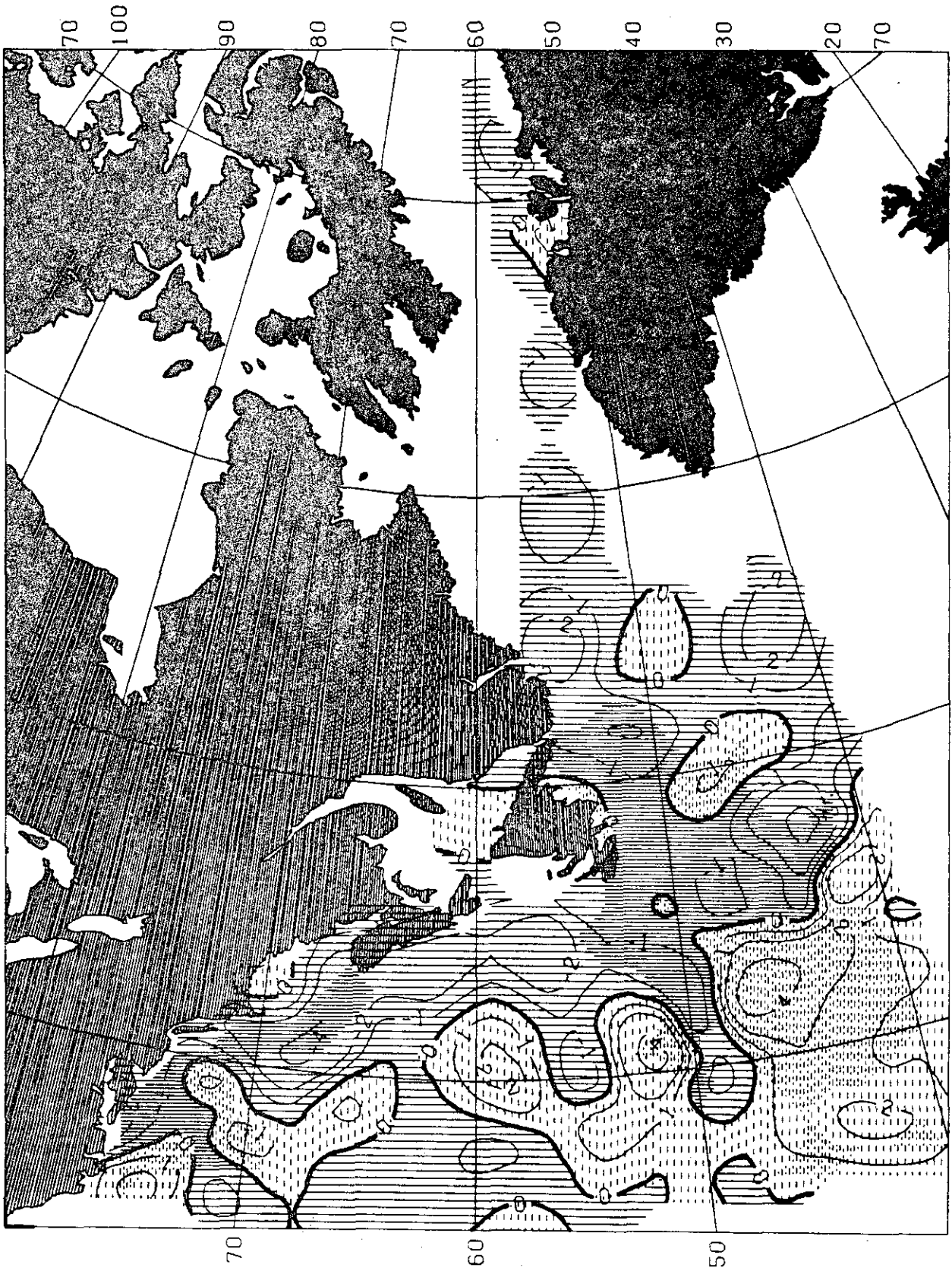
As a comparison, the seasonal anomaly maps have also been generated. These used the same values of the four parameters as was used for the 1985 displays.

References

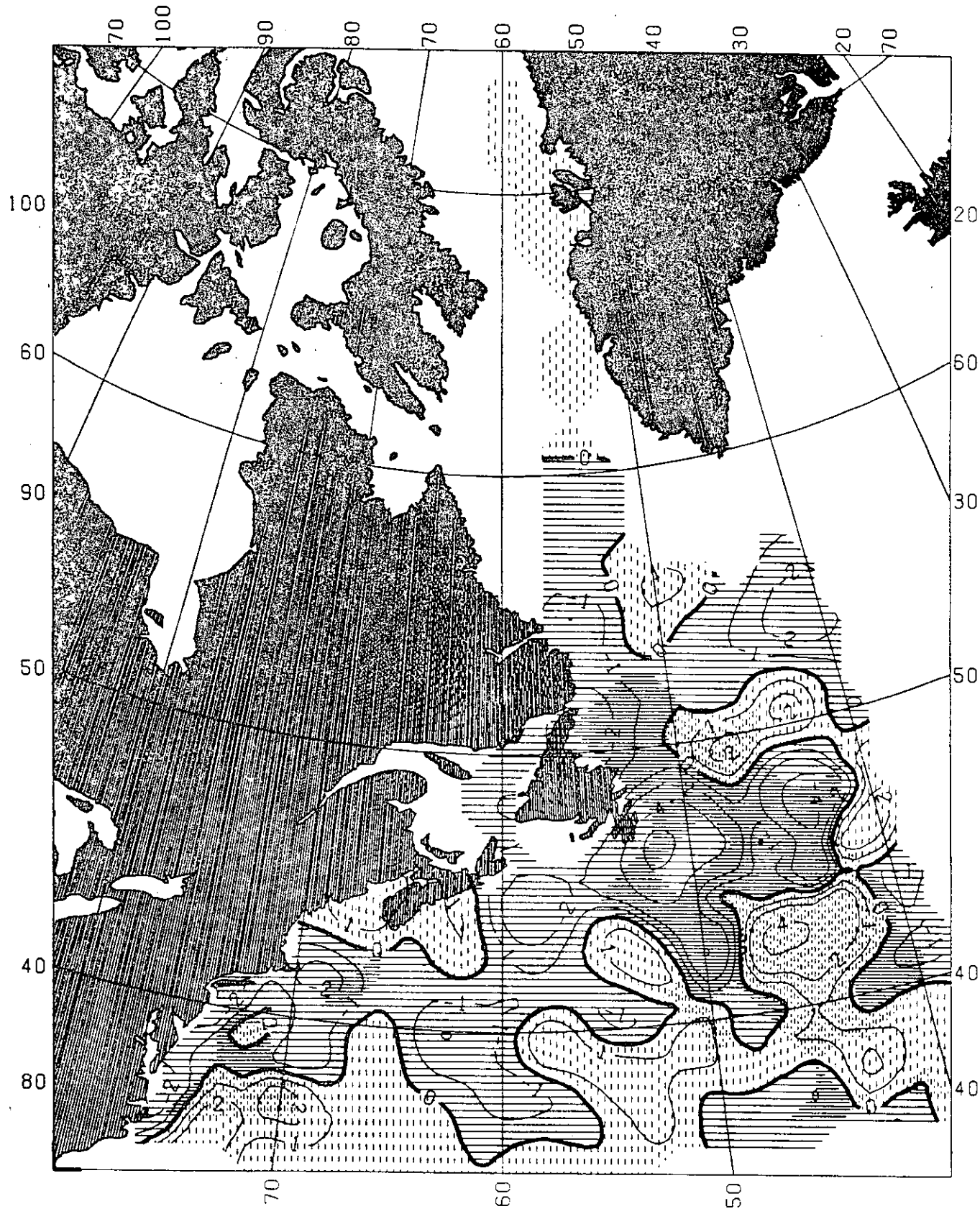
Keeley, J.R., Marine Environmental Data Service Report for 1984/85, Northwest Atlantic Fisheries Organization, SCR Doc 85/71, 36 pp., 1985.

Keeley, J.R., Temperature Anomalies in the Northwest Atlantic in 1986., submitted to Oceans'87, 1987.

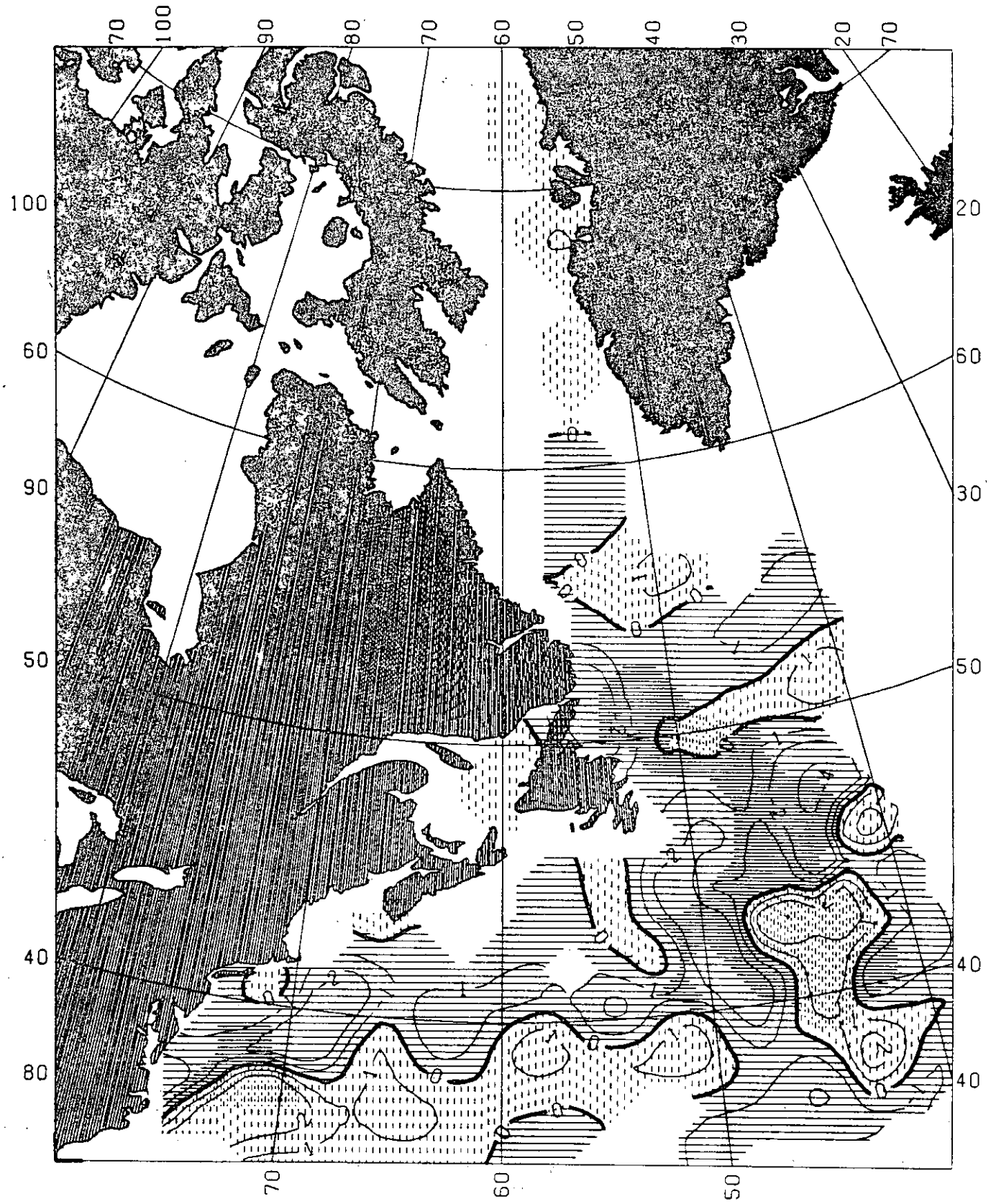
Levitus, S., Climatological Atlas of the World Ocean, NOAA Professional Paper #13, U.S. Department of Commerce, 173 pp., 1982.



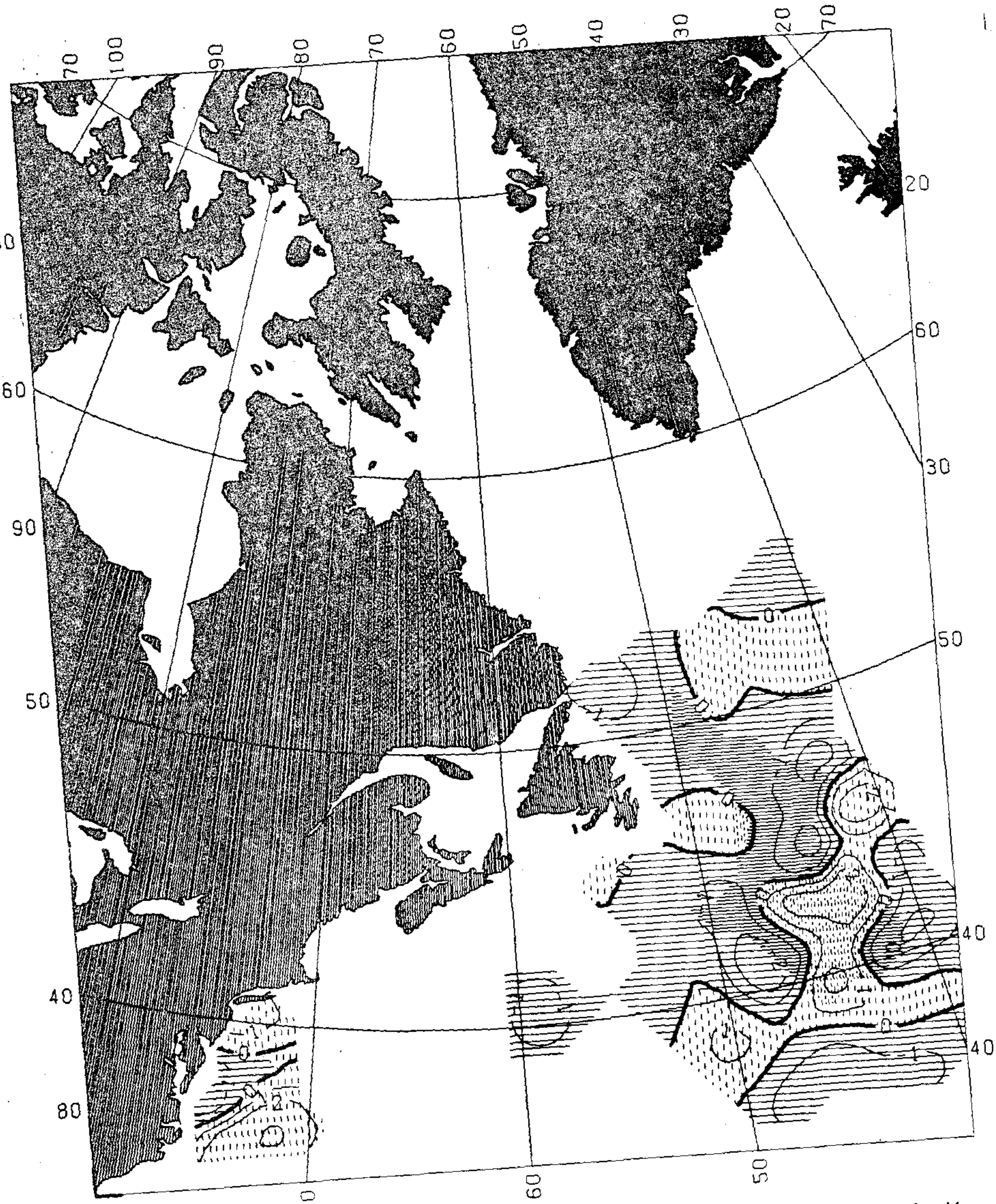
TEMPERATURE ANOMALY (DEG C) IN SPRING AT 0 M.



TEMPERATURE ANOMALY (DEG C) IN SPRING AT 100 M.



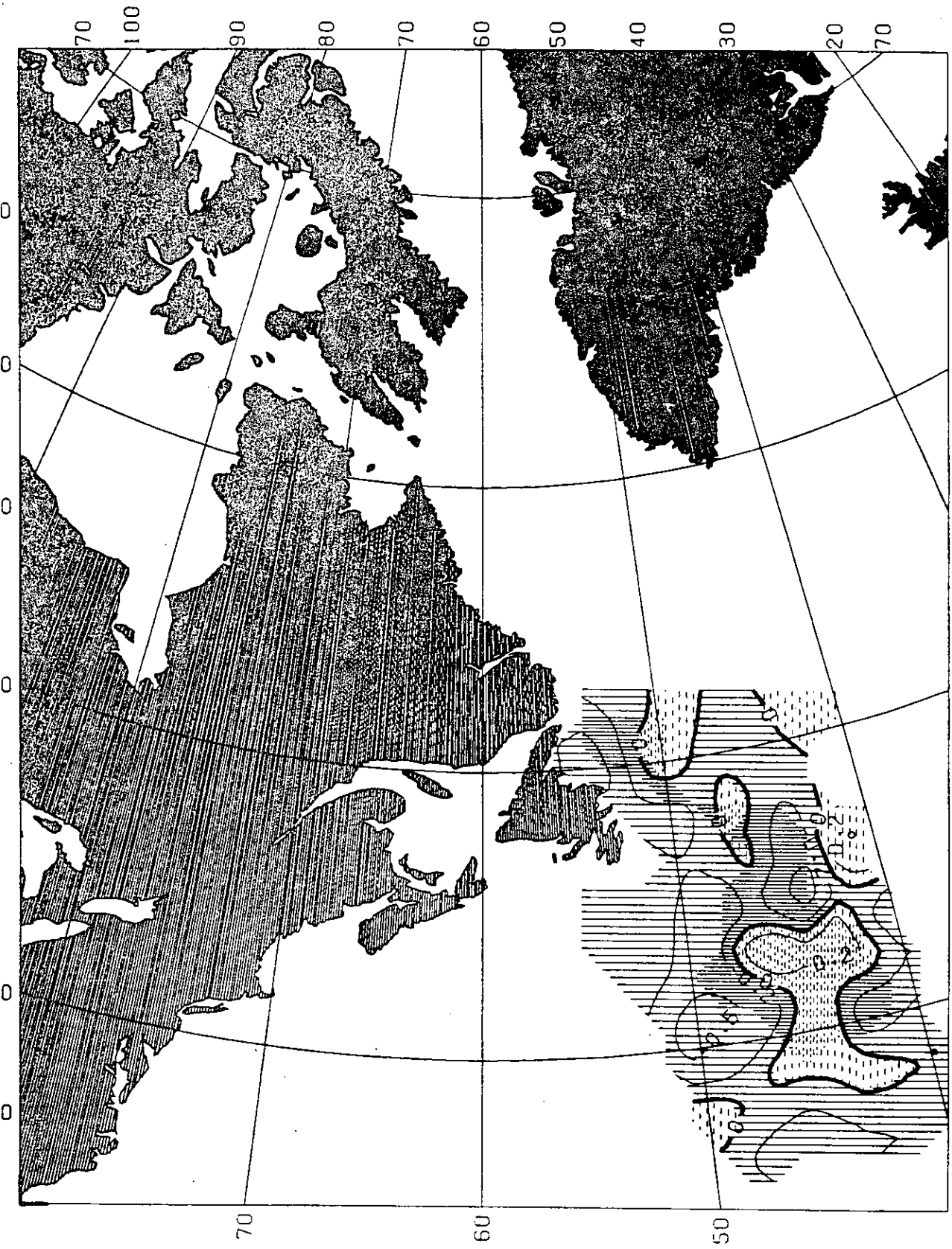
TEMPERATURE ANOMALY (DEG C) IN SPRING AT 250 M.



TEMPERATURE ANOMPLY (DEG C) IN SPRING AT 500 M.

SALINITY ANOMALY IN SPRING AT 0 M.

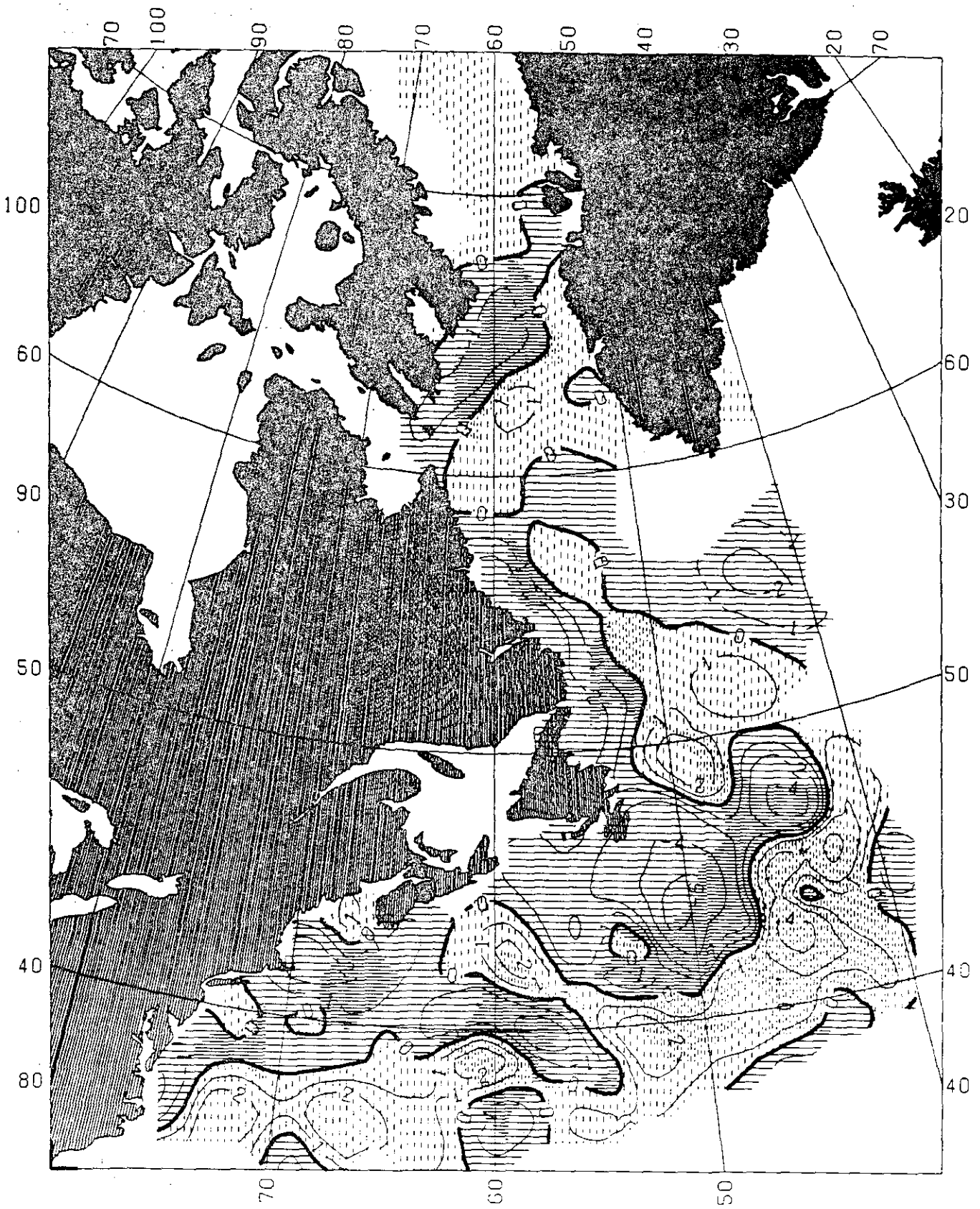
SALINITY ANOMALY IN SPRING AT 100 M.



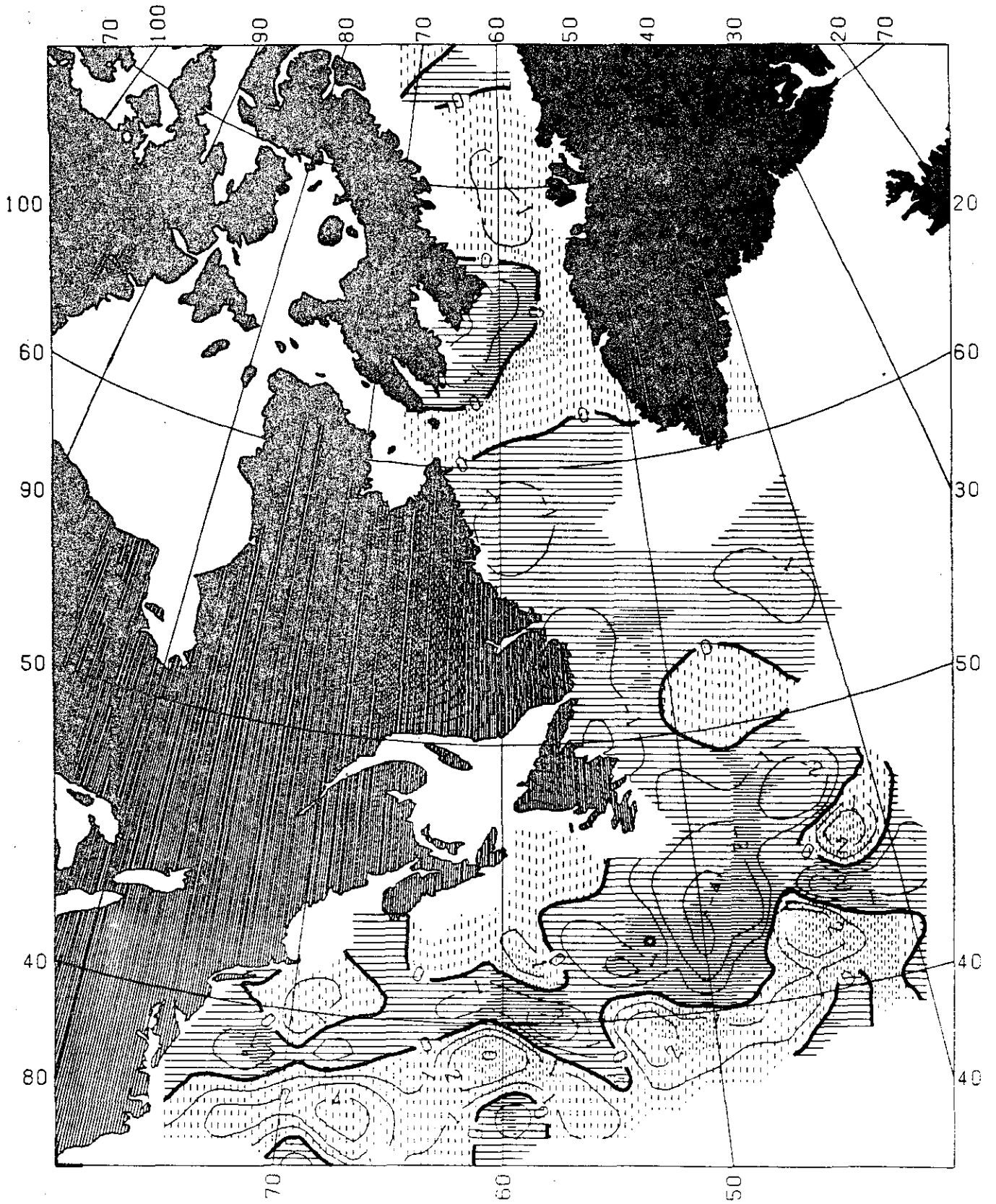
SALINITY ANOMALY IN SPRING AT 250 M.

SALINITY ANOMALY IN SPRING AT 500 M.

TEMPERATURE ANOMALY (DEG C) IN SUMMER AT 0 M.



TEMPERATURE ANOMALY (DEG C) IN SUMMER AT 100 M.

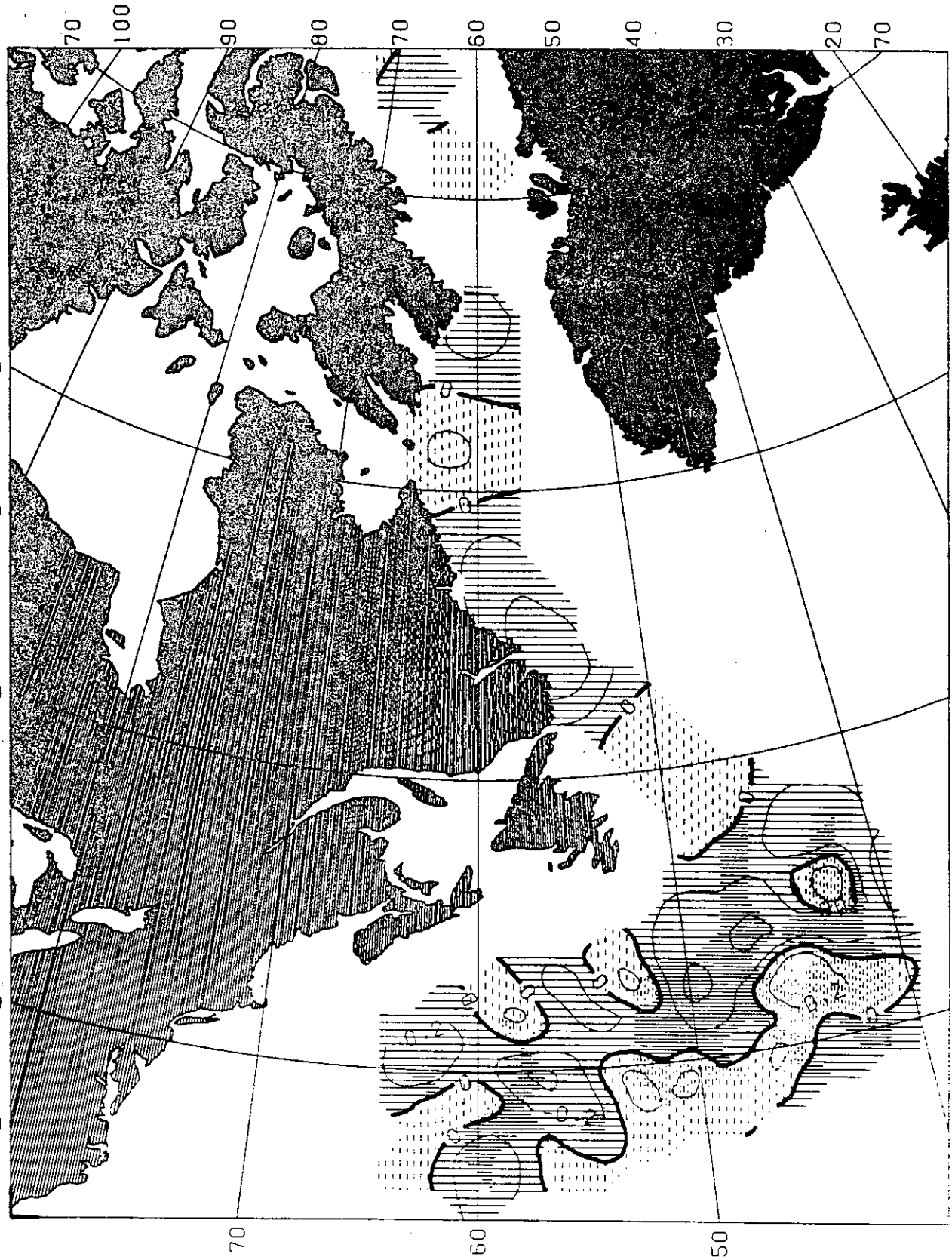


TEMPERATURE ANOMALY (DEG C) IN SUMMER AT 250 M.

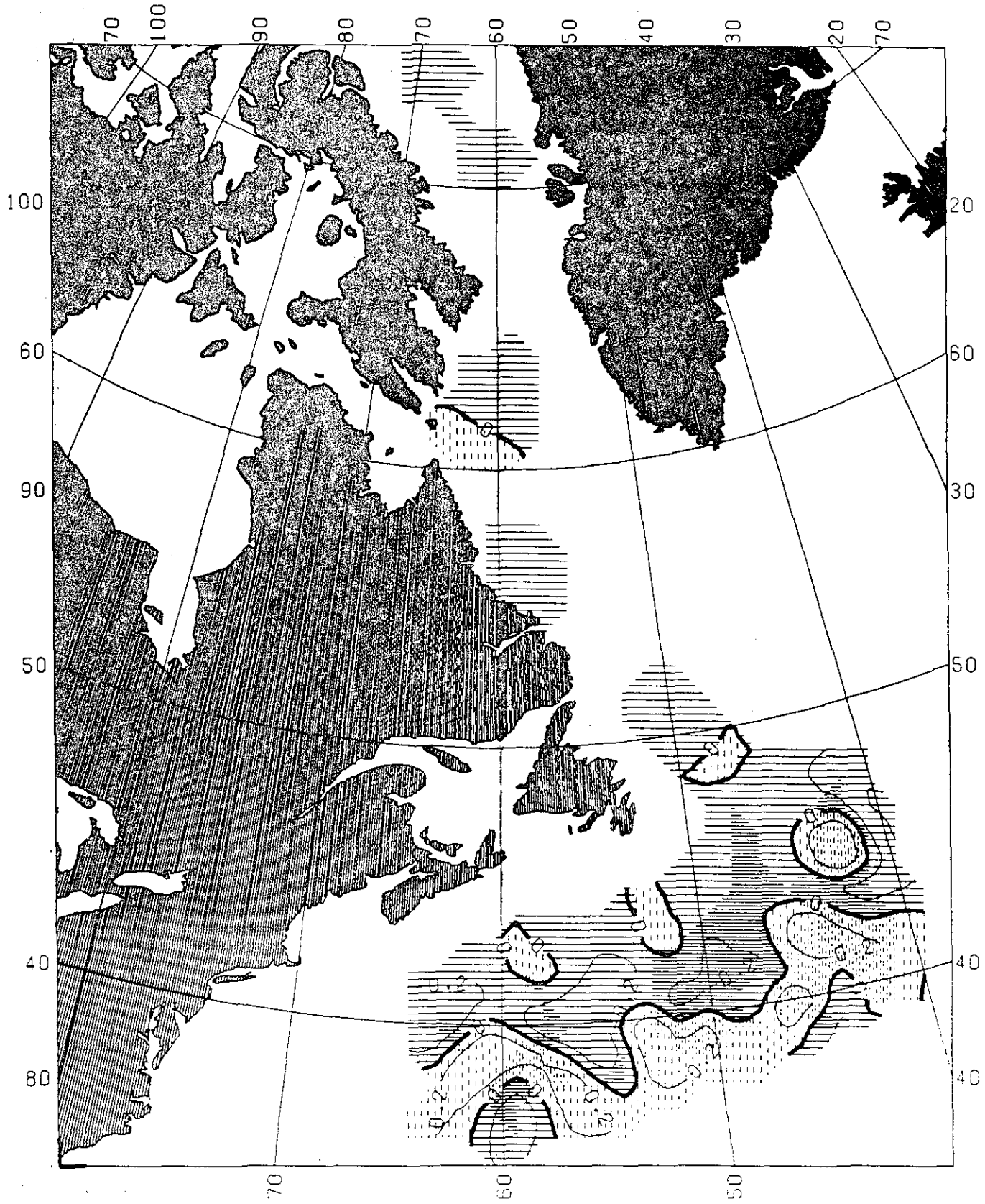
TEMPERATURE ANOMALY (DEG C) IN SUMMER AT 500 M.

SALINITY ANOMALY IN SUMMER AT 0 M.

SALINITY ANOMALY IN SUMMER AT 100 M.

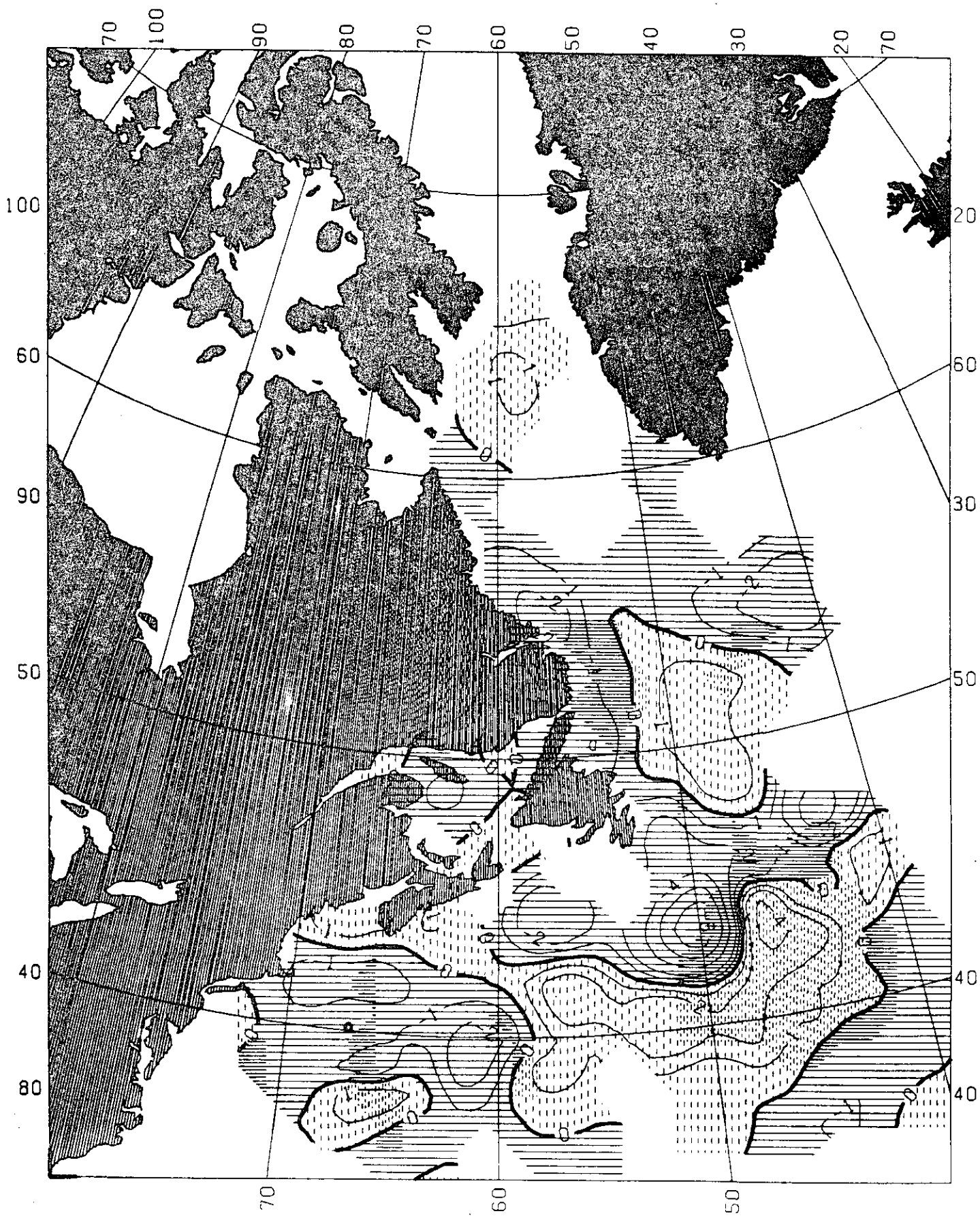


SALINITY ANOMALY IN SUMMER AT 250 M.



SALINITY ANOMALY IN SUMMER AT 500 M.

TEMPERATURE ANOMALY (DEG C) IN AUTUMN AT 0 M.



TEMPERATURE ANOMALY (DEG C) IN AUTUMN AT 100 M.

TEMPERATURE ANOMALY (DEG C) IN AUTUMN AT 250 M.

TEMPERATURE ANOMALY (DEG C) IN AUTUMN AT 500 M.

SALINITY ANOMALY IN AUTUMN AT 0 M.

SALINITY ANOMALY IN AUTUMN AT 100 M.

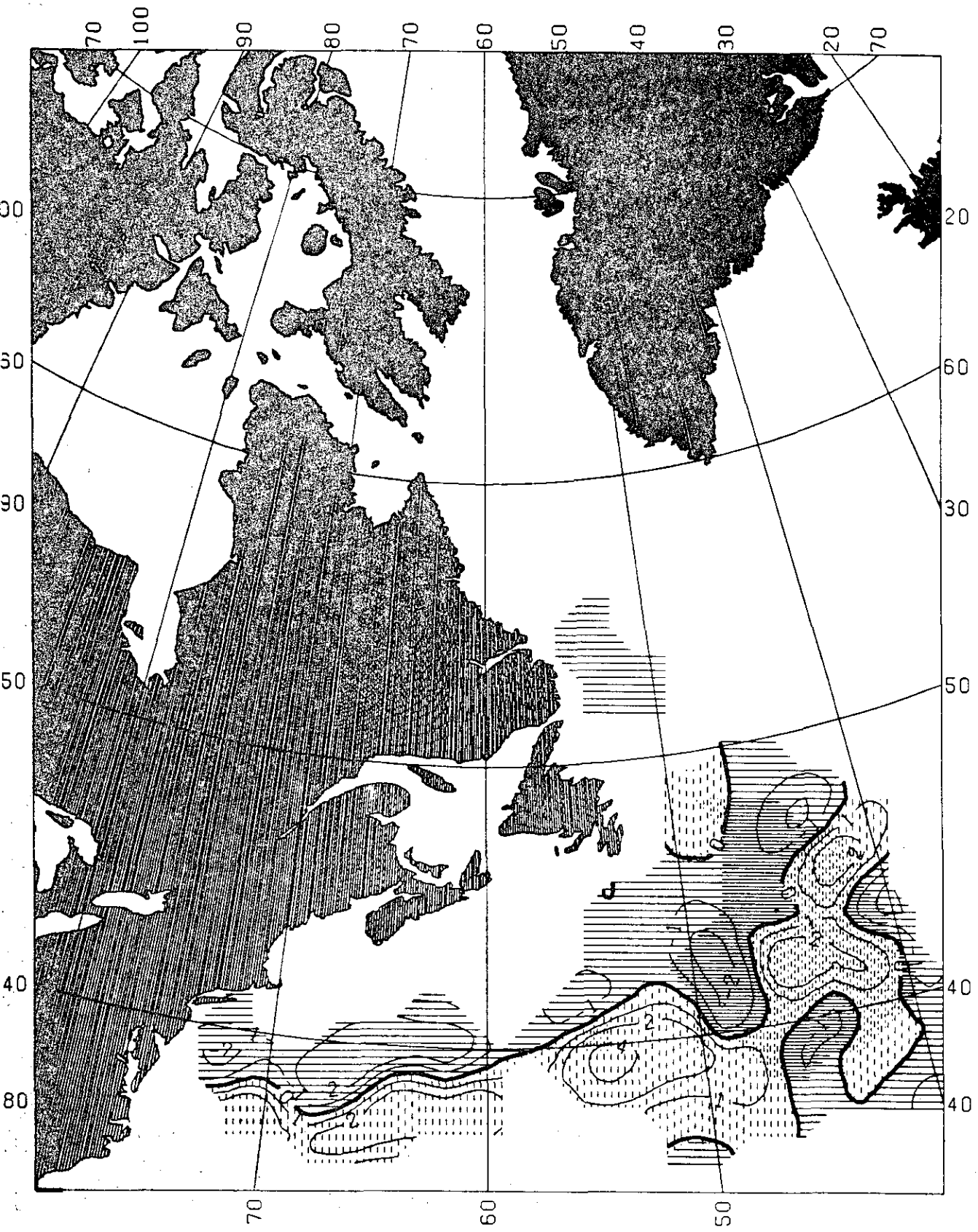
SALINITY ANOMALY IN AUTUMN AT 250 M.

SALINITY ANOMALY IN AUTUMN AT 500 M.

TEMPERATURE ANOMALY (DEG C) IN WINTER AT 0 M.

TEMPERATURE ANOMALY (DEG C) IN WINTER AT 100 M.

TEMPERATURE ANOMALY (DEG C) IN WINTER AT 250 M.

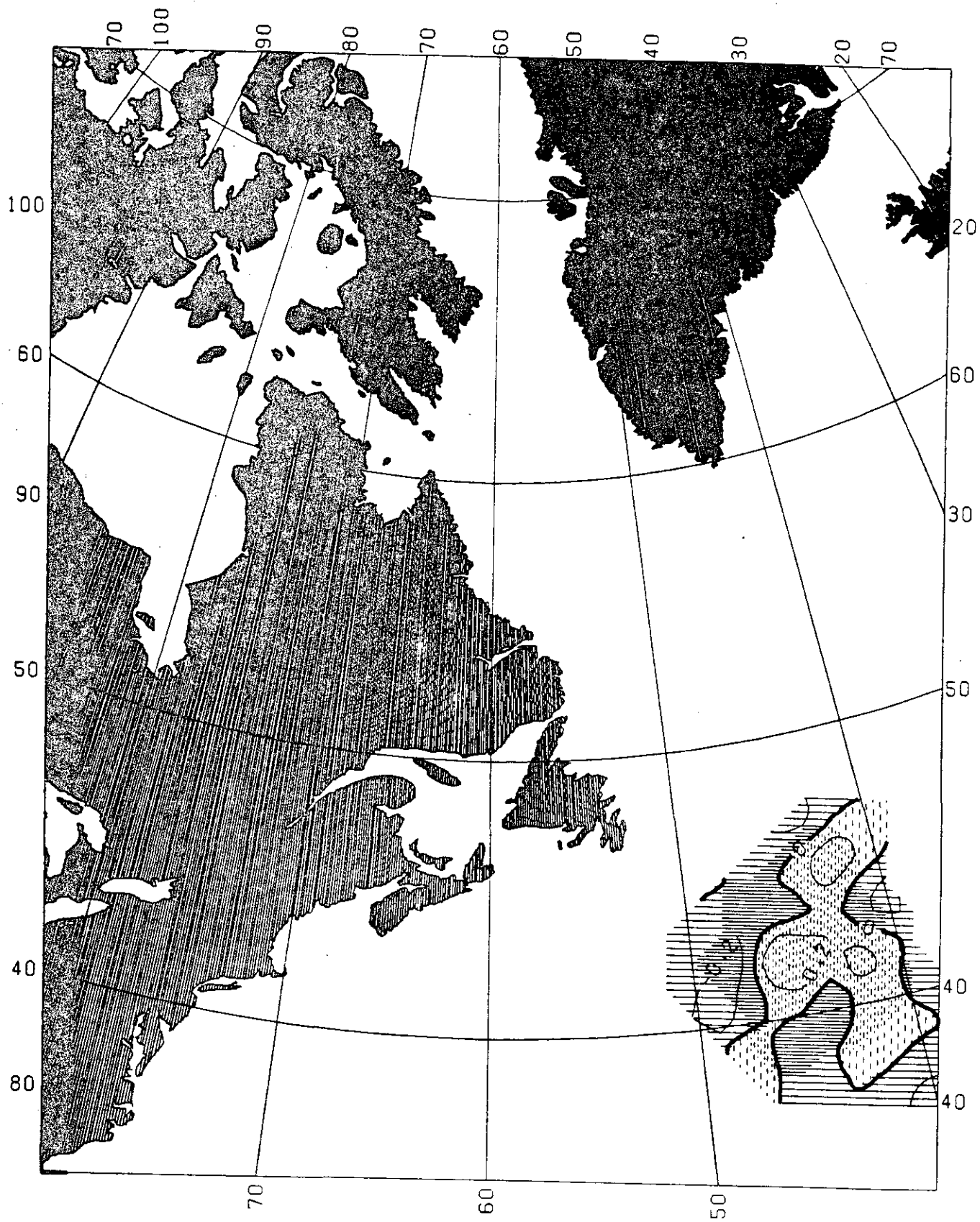


TEMPERATURE ANOMALY (DEG C) IN WINTER AT 500 M.

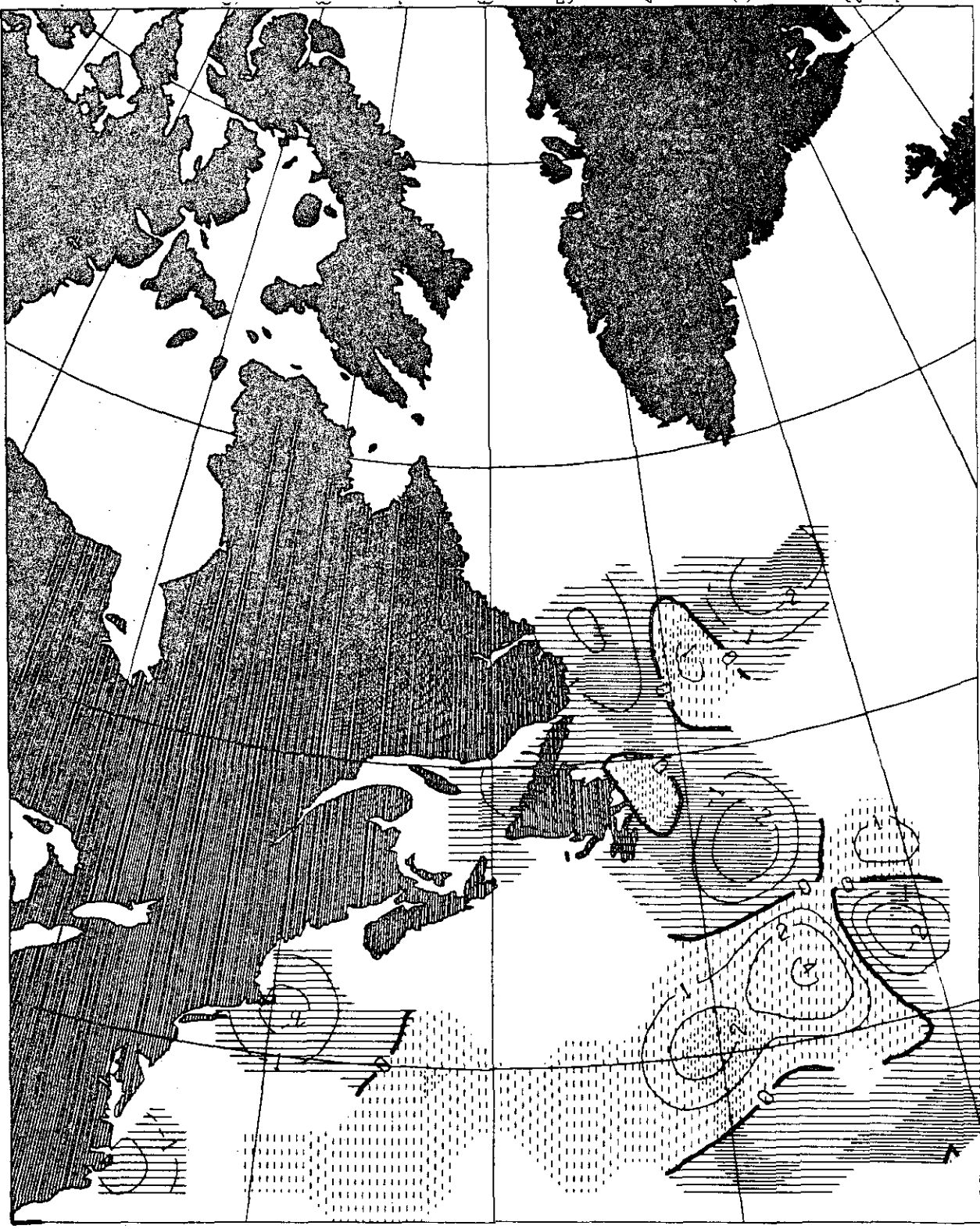
SALINITY ANOMALY IN WINTER AT 0 M.

SALINITY ANOMALY IN WINTER AT 100 M.

SALINITY ANOMALY IN WINTER AT 250 M.



SALINITY ANOMALY IN WINTER AT 500 M.

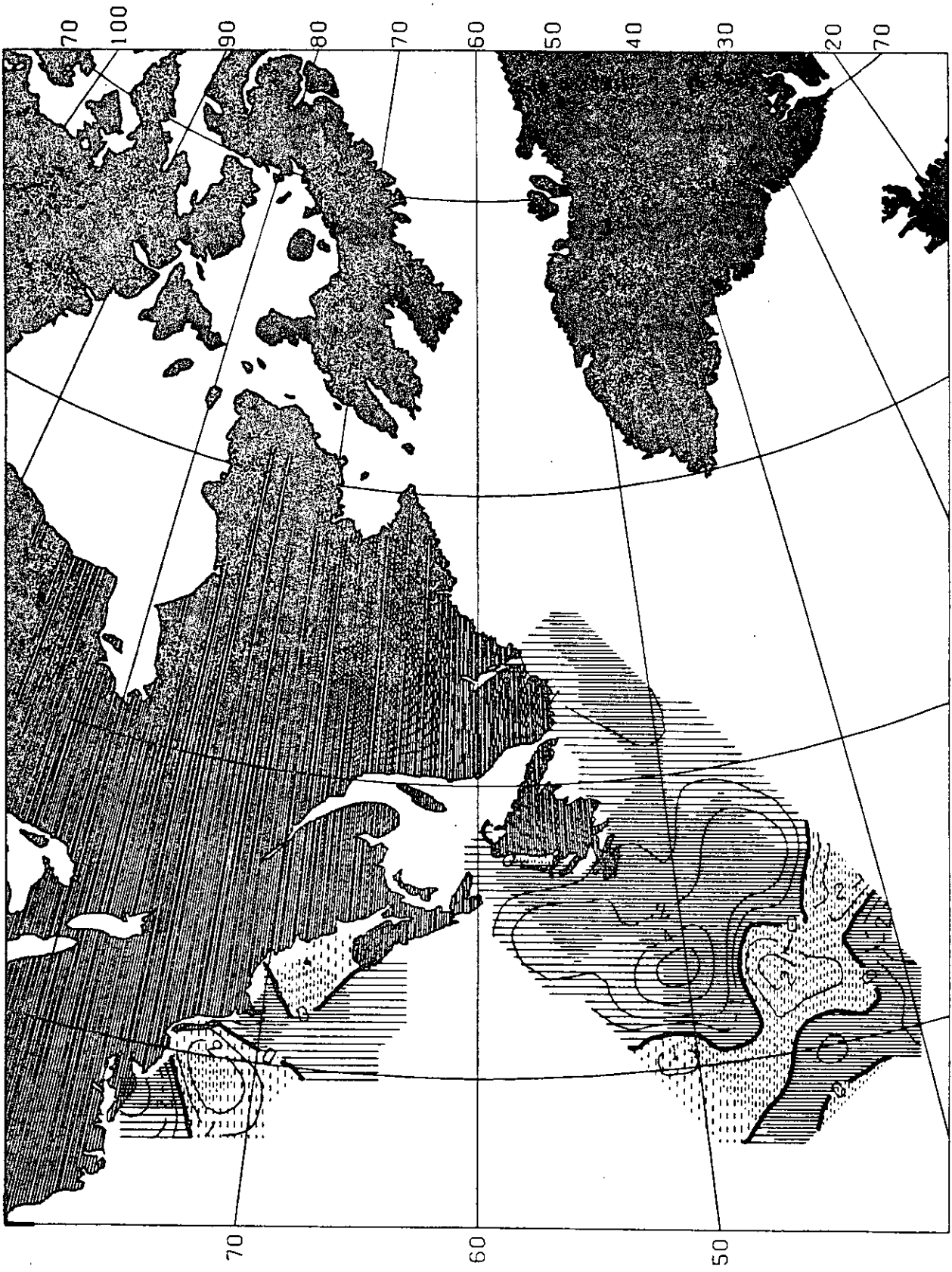


TEMPERATURE ANOMALY (DEG C) IN JANUARY AT 0 M.

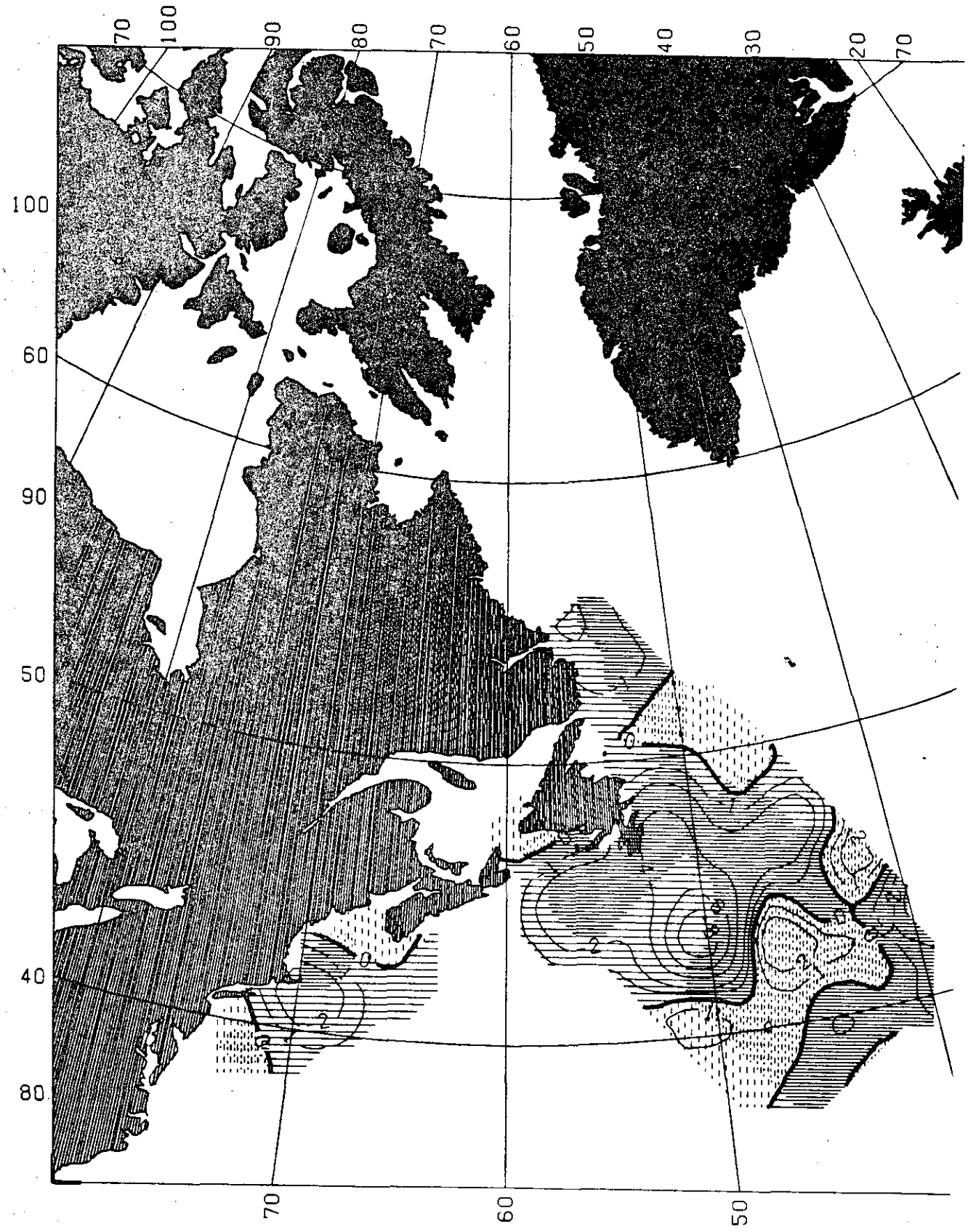
TEMPERATURE ANOMALY (DEG C) IN JANUARY AT 100 M.

TEMPERATURE ANOMALY (DEG C) IN JANUARY AT 250 M.

TEMPERATURE ANOMALY (DEG C) IN JANUARY AT 500 M.



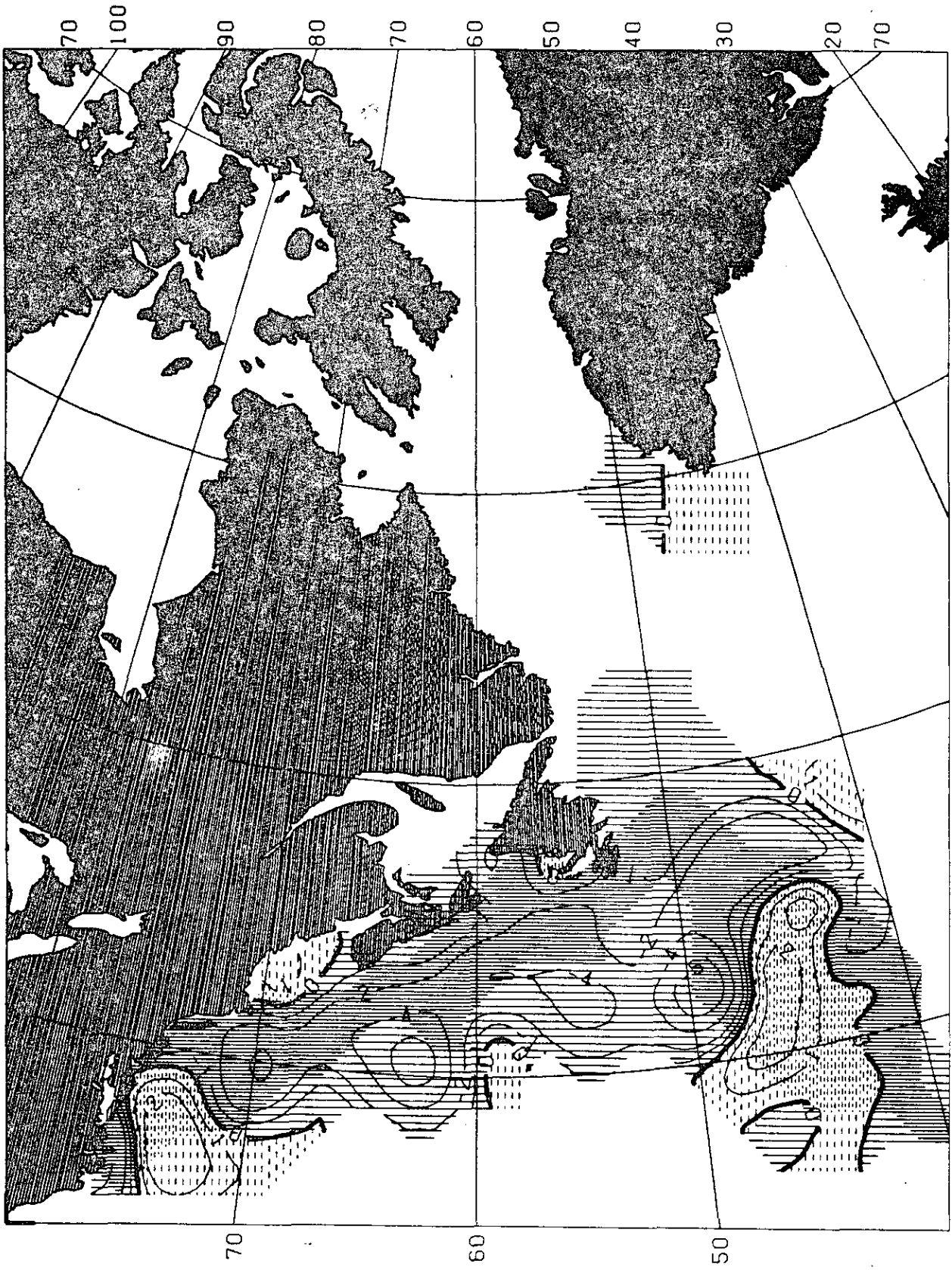
TEMPERATURE ANOMALY (DEG C) IN FEBRUARY AT 0 M.



TEMPERATURE ANOMALY (DEG C) IN FEBRUARY AT 100

TEMPERATURE ANOMALY (DEG C) IN FEBRUARY AT 250 M.

TEMPERATURE ANOMALY (DEG C) IN FEBRUARY AT 500 M.



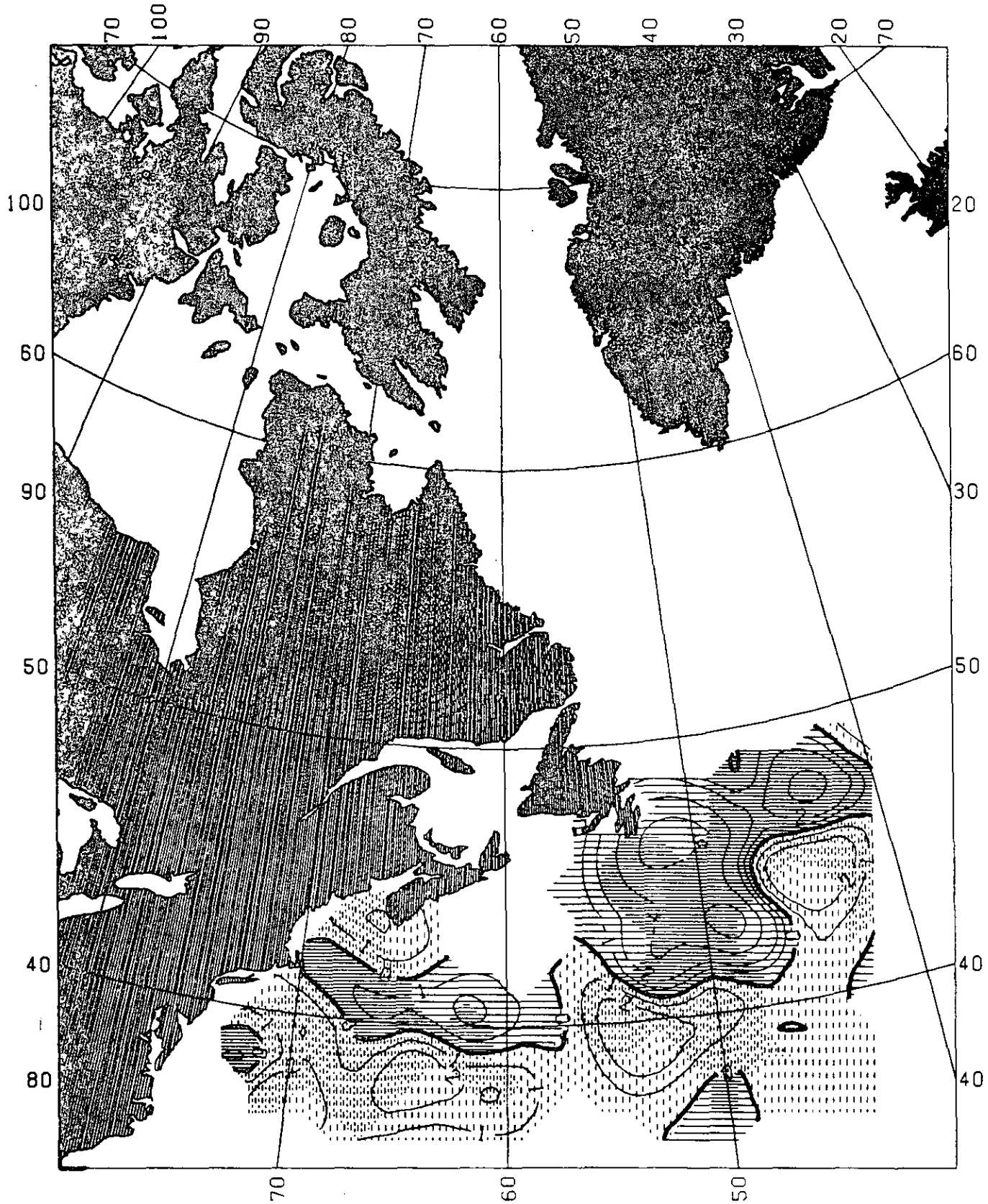
TEMPERATURE ANOMALY (DEG C) IN MARCH AT 0 M.

TEMPERATURE ANOMALY (DEG C) IN MARCH AT 100 M.

TEMPERATURE ANOMALY (DEG C) IN MARCH AT 250 M.

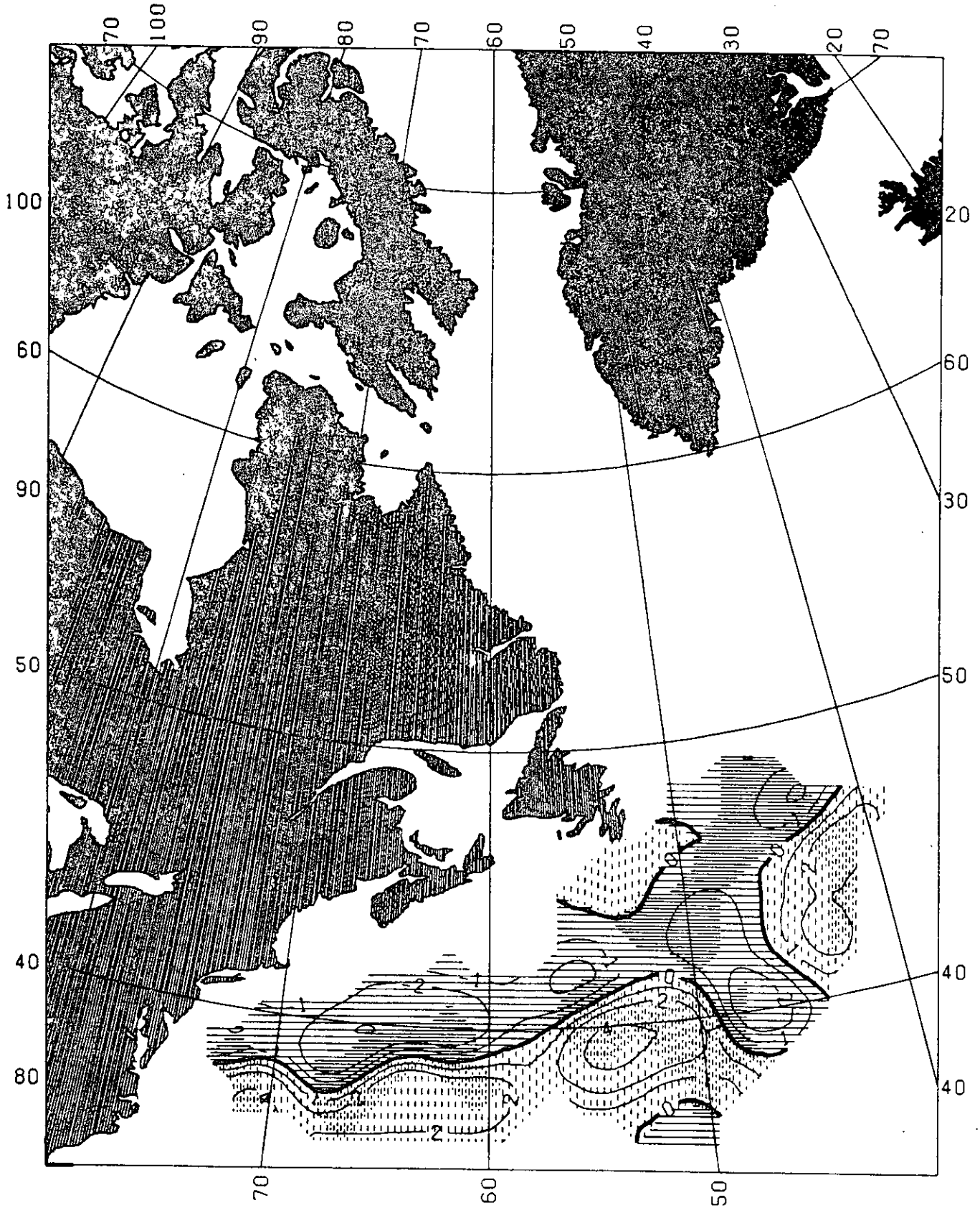
TEMPERATURE ANOMALY (DEG C) IN MARCH AT 500 M.

TEMPERATURE ANOMALY (DEG C) IN APRIL AT 0 M.

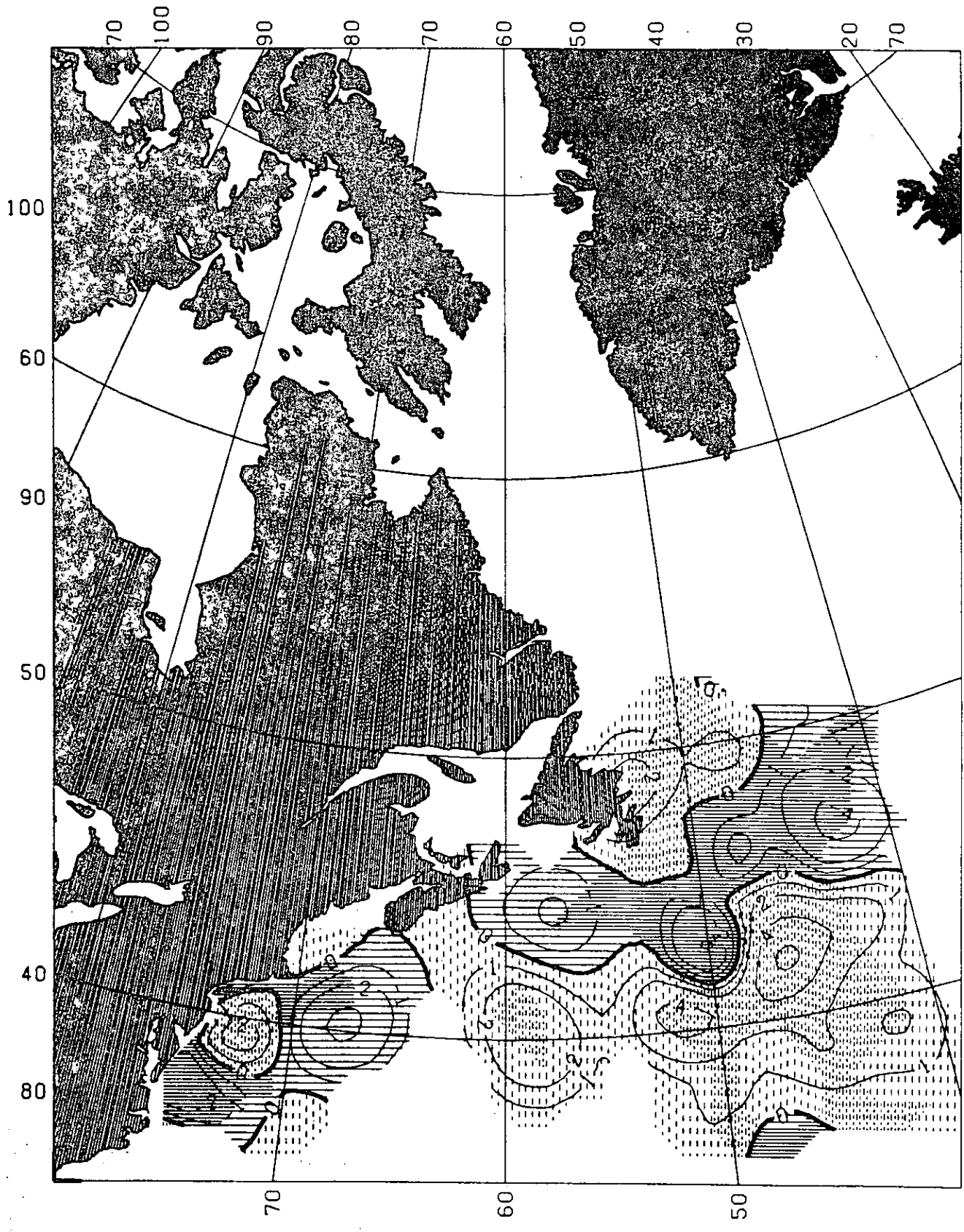


TEMPERATURE ANOMALY (DEG C) IN APRIL AT 100 M.

TEMPERATURE ANOMALY (DEG C) IN APRIL AT 250 M.

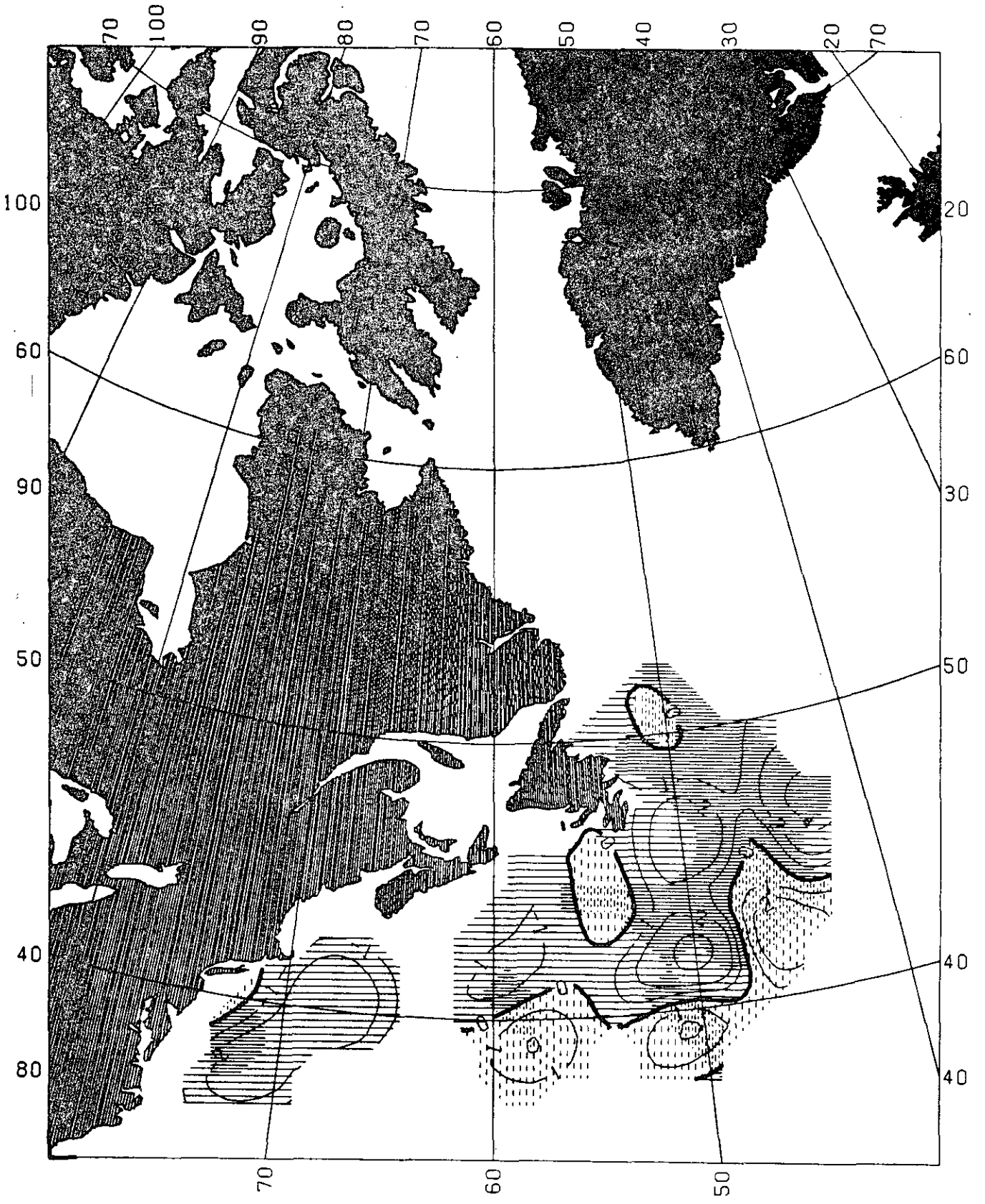


TEMPERATURE ANOMALY (DEG C) IN APRIL AT 500 M.



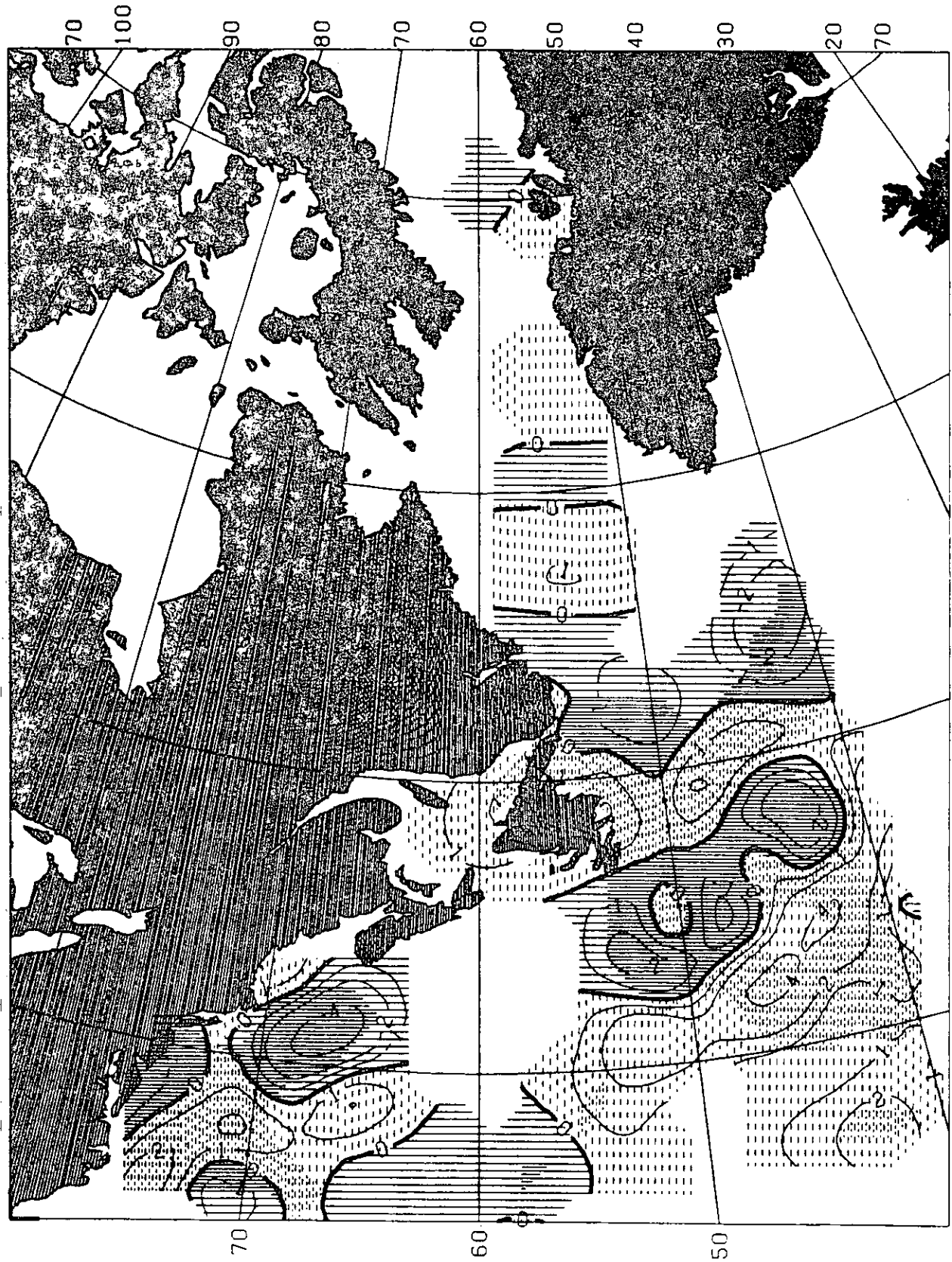
TEMPERATURE ANOMALY (DEG C) IN MAY AT 0 M.

TEMPERATURE ANOMALY (DEG C) IN MAY AT 100 M.



TEMPERATURE ANOMALY (DEG C) IN MAY AT 250 M.

TEMPERATURE ANOMALY (DEG C) IN MAY AT 500 M.

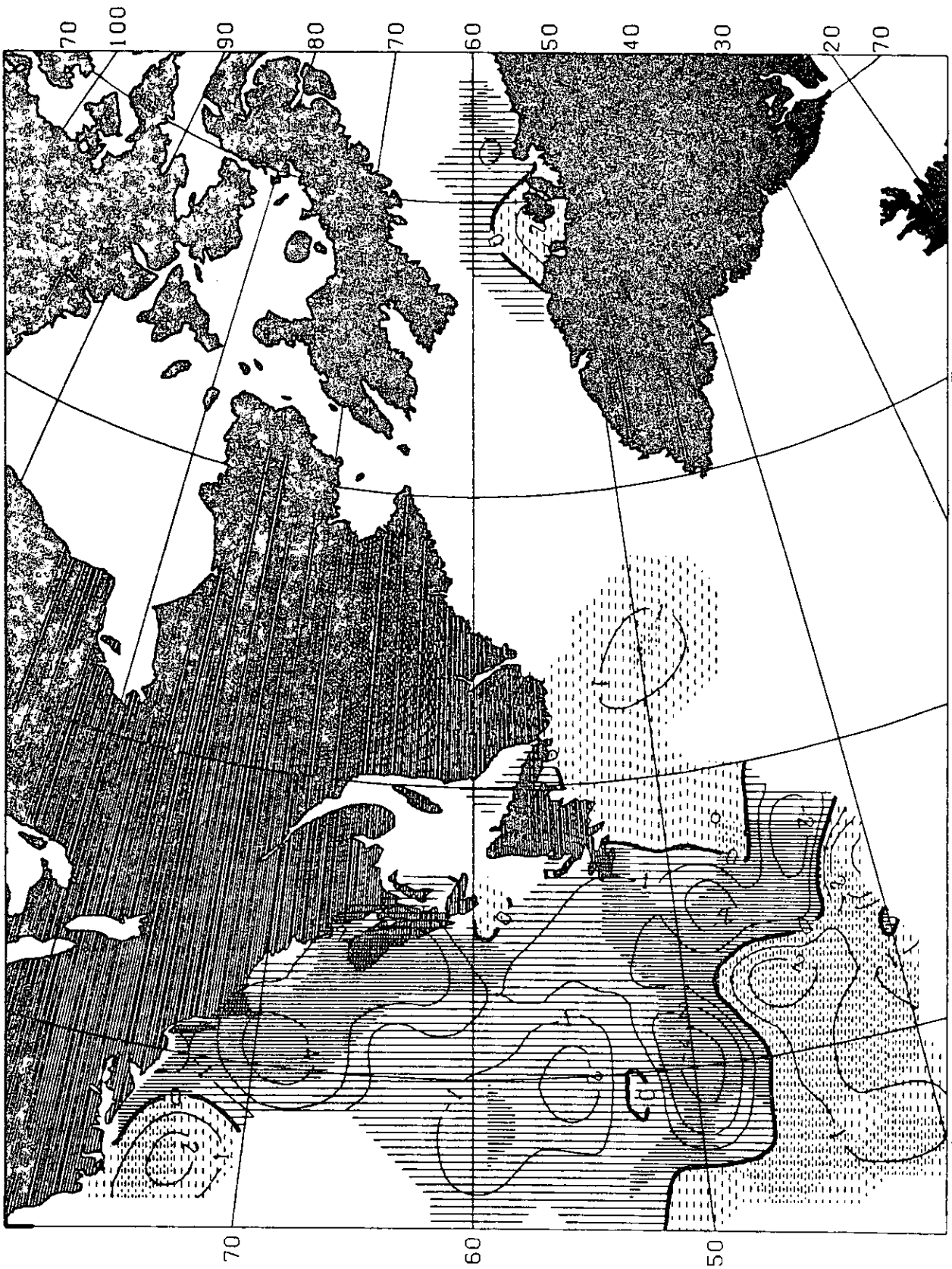


TEMPERATURE ANOMALY (DEG C) IN JUNE AT 0 M.

TEMPERATURE ANOMALY (DEG C) IN JUNE AT 100 M.

TEMPERATURE ANOMALY (DEG C) IN JUNE AT 250 M.

TEMPERATURE ANOMALY (DEG C) IN JUNE AT 500 M.

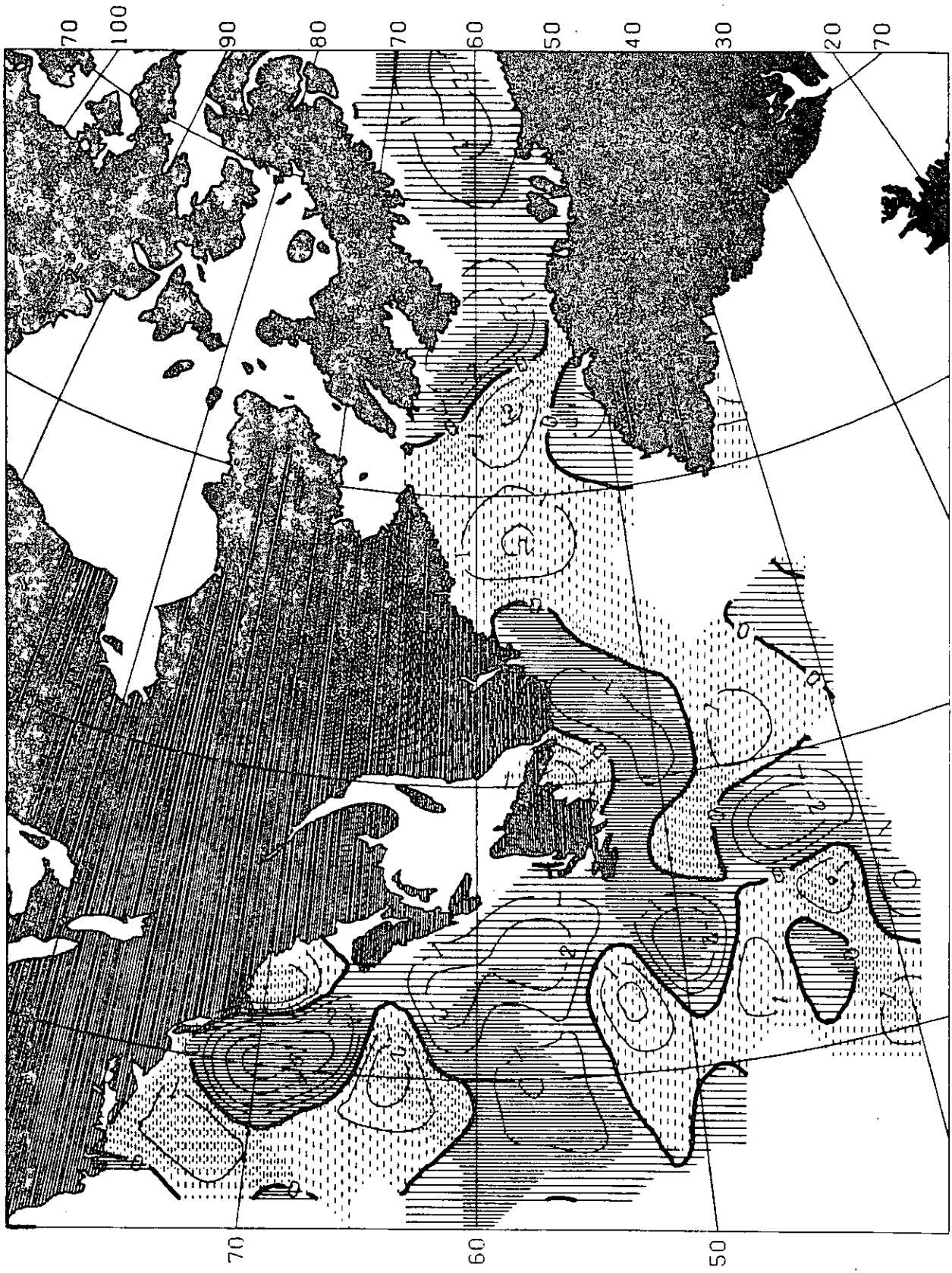


TEMPERATURE ANOMALY (DEG C) IN JULY AT 0 M.

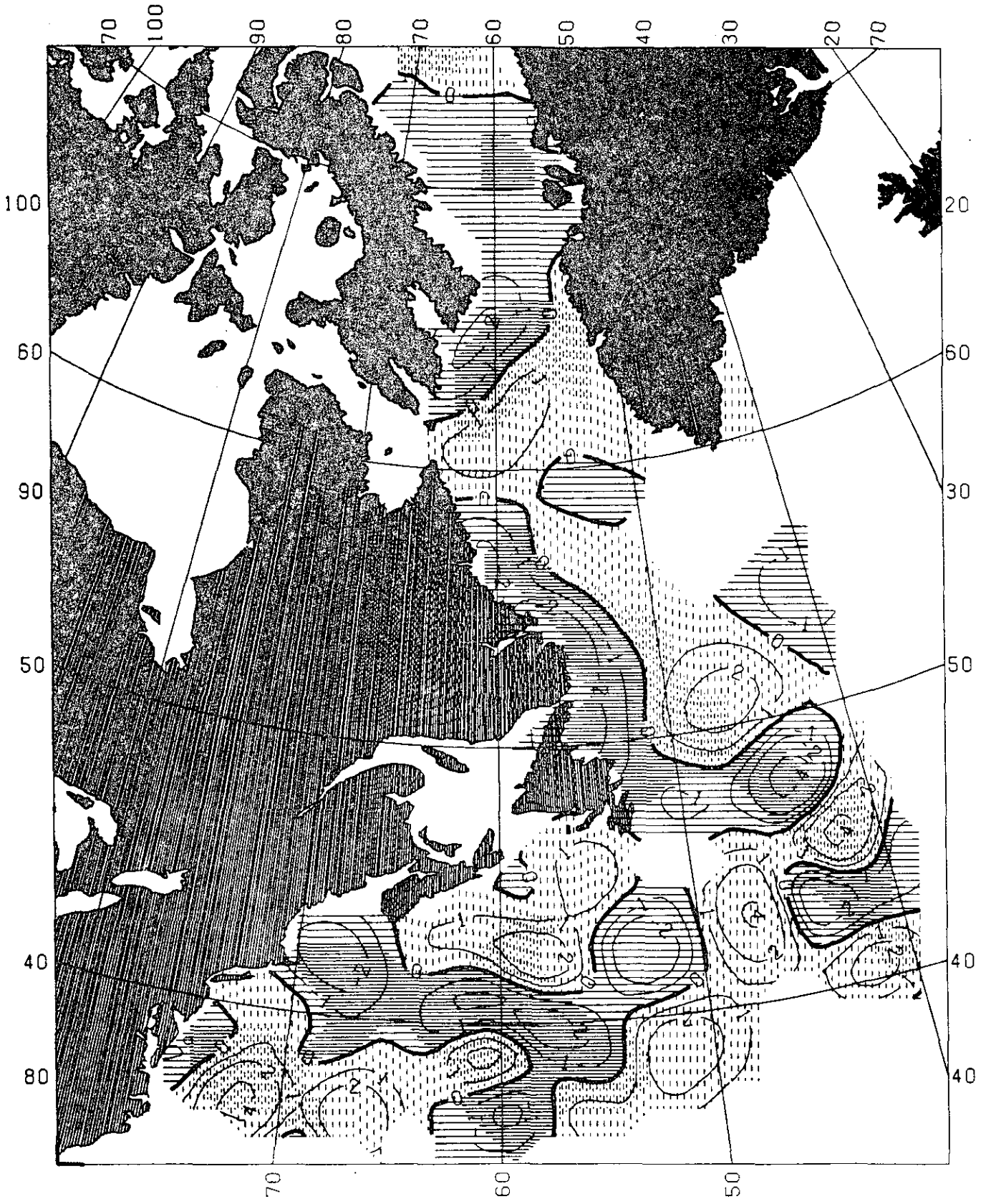
TEMPERATURE ANOMALY (DEG C) IN JULY AT 100 M.

TEMPERATURE ANOMALY (DEG C) IN JULY AT 250 M.

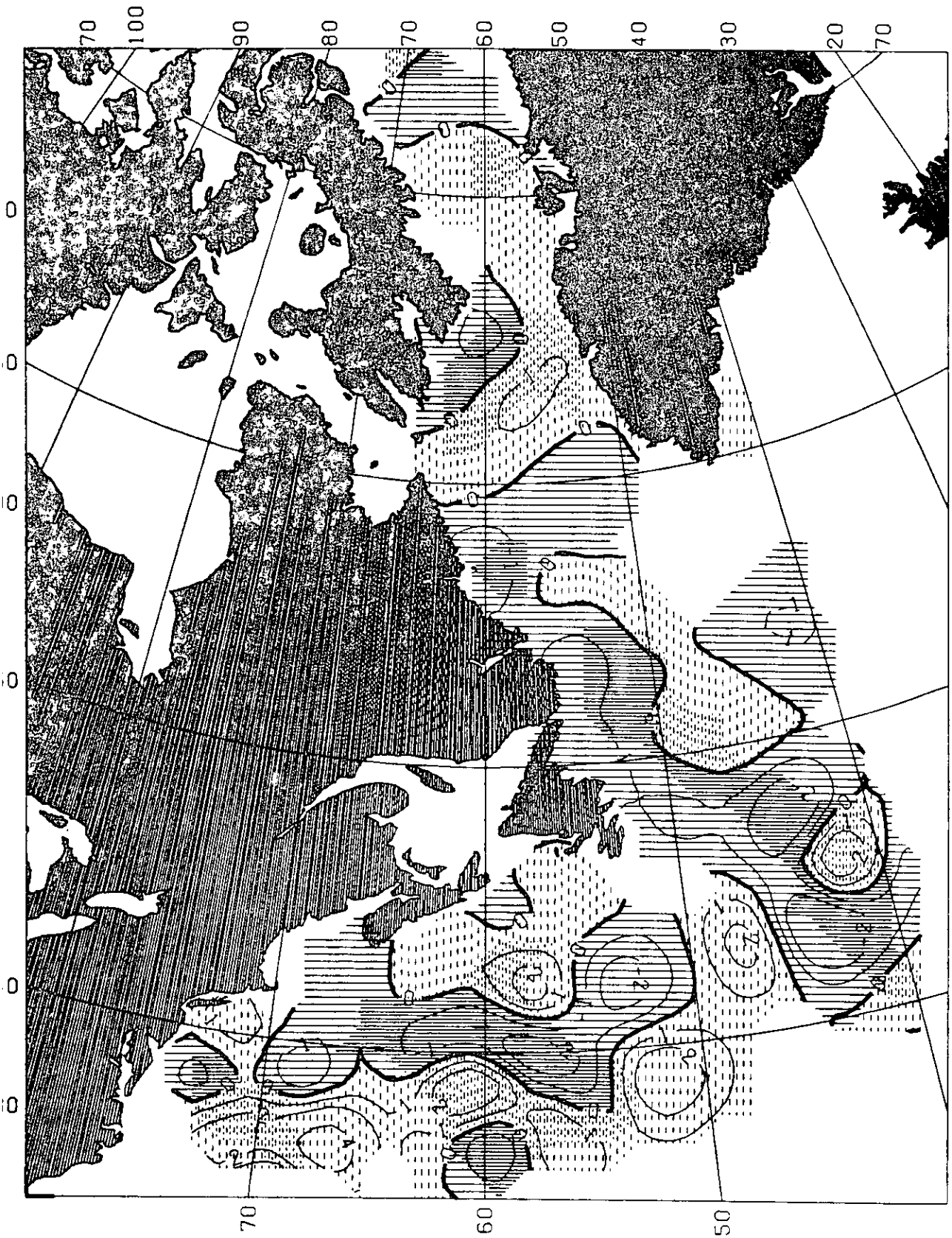
TEMPERATURE ANOMALY (DEG C) IN JULY AT 500 M.



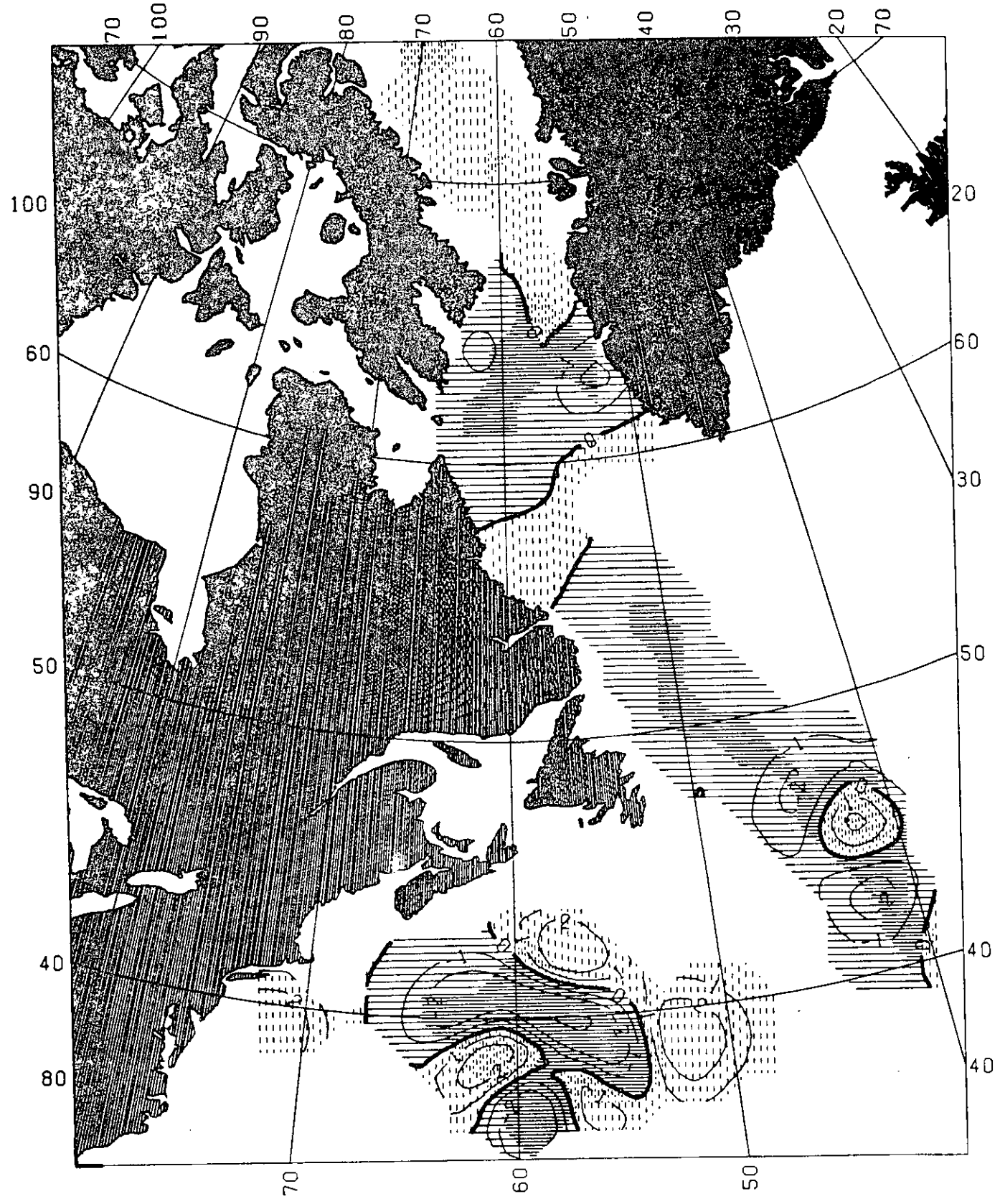
TEMPERATURE ANOMALY (DEG C) IN AUGUST AT 0 M.



TEMPERATURE ANOMALY (DEG C) IN AUGUST AT 100 M.



TEMPERATURE ANOMALY (DEG C) IN AUGUST AT 250 M.



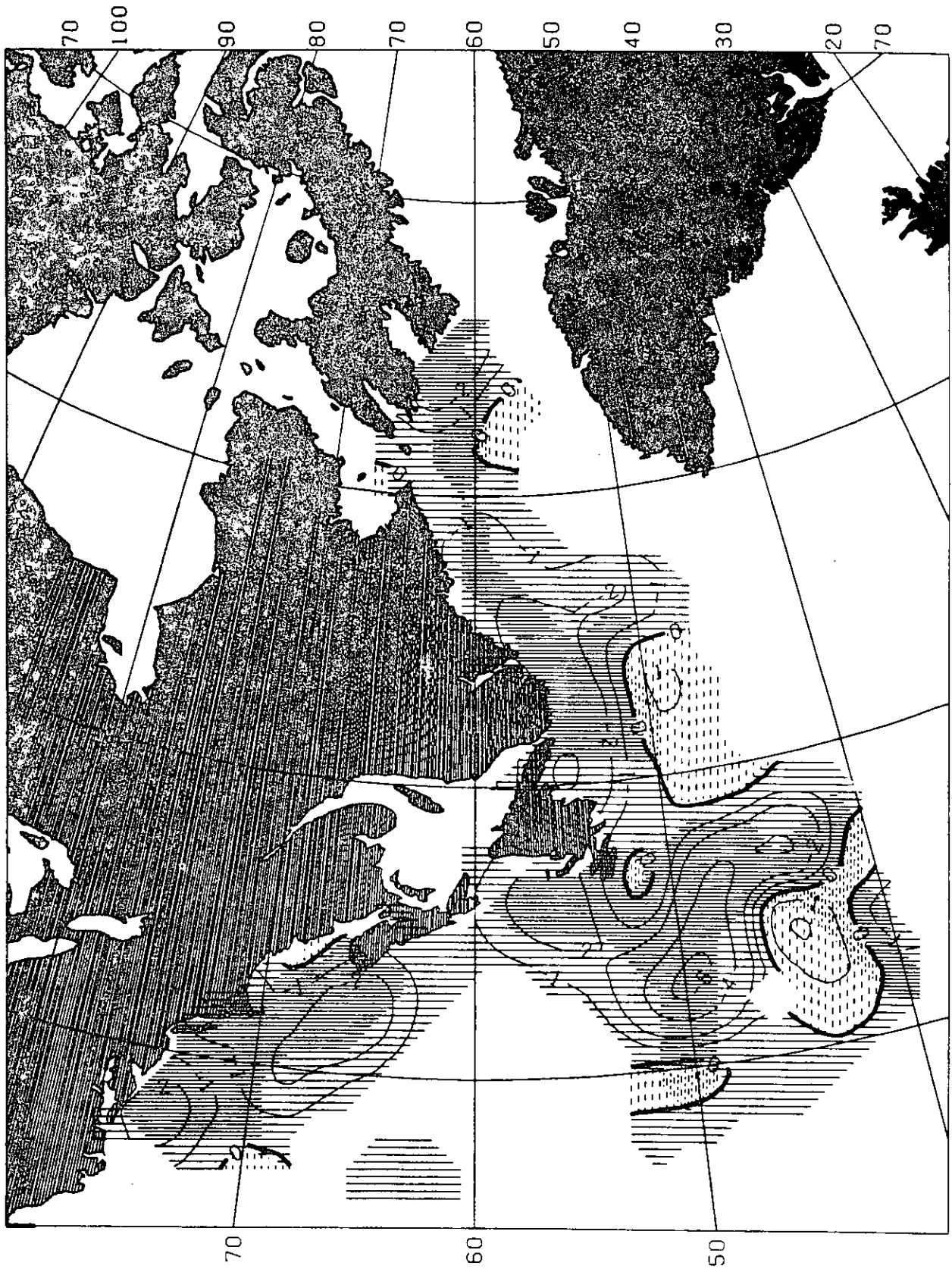
TEMPERATURE ANOMALY (DEG C) IN AUGUST AT 500 M.

TEMPERATURE ANOMALY (DEG C) IN SEPTEMBER AT 0 M.

TEMPERATURE ANOMALY (DEG C) IN SEPTEMBER AT 100 M.

TEMPERATURE ANOMALY (DEG C) IN SEPTEMBER AT 250

TEMPERATURE ANOMALY (DEG C) IN SEPTEMBER AT 500 M.

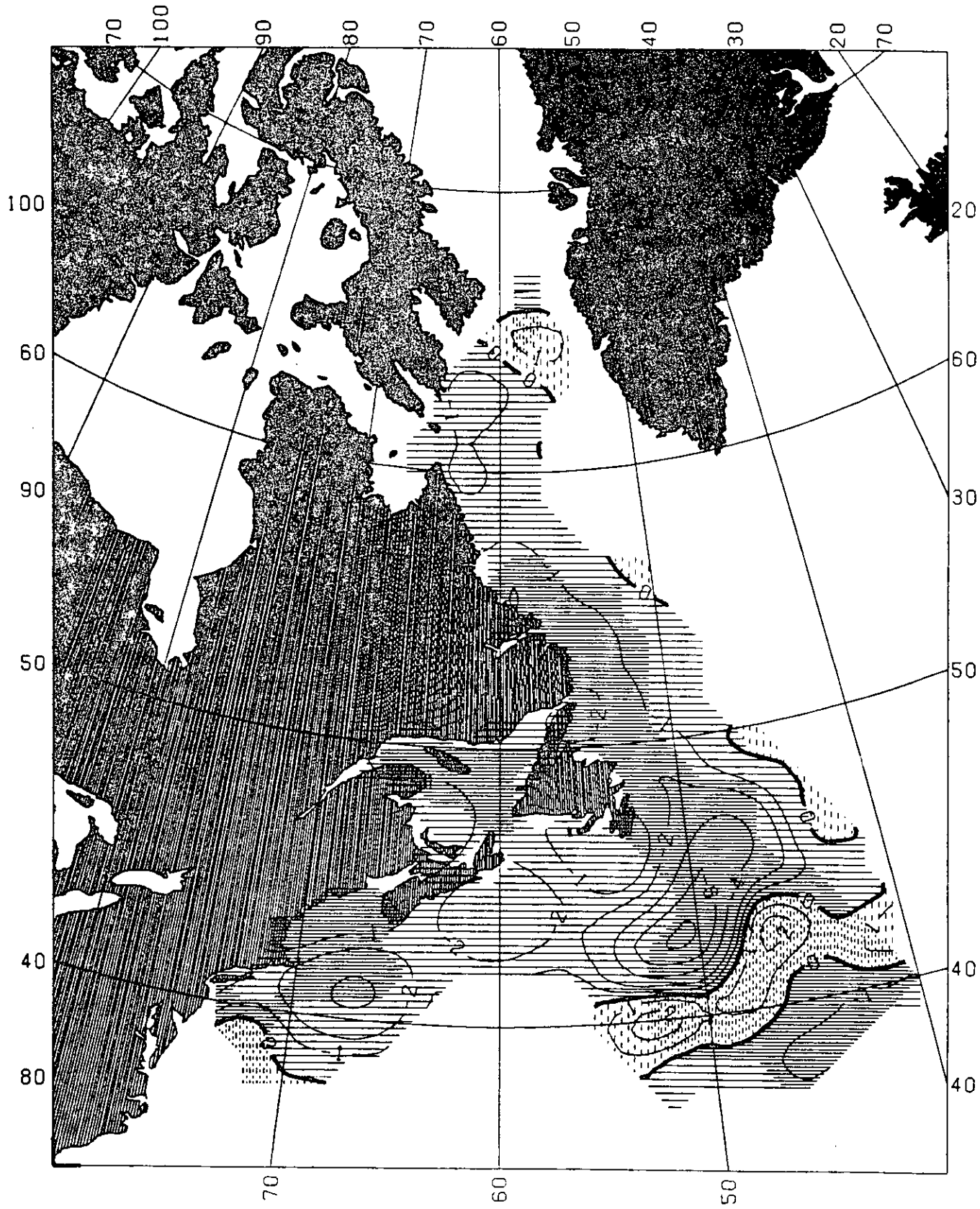


TEMPERATURE ANOMALY (DEG C) IN OCTOBER AT 0 M.

TEMPERATURE ANOMALY (DEG C) IN OCTOBER AT 100 M.

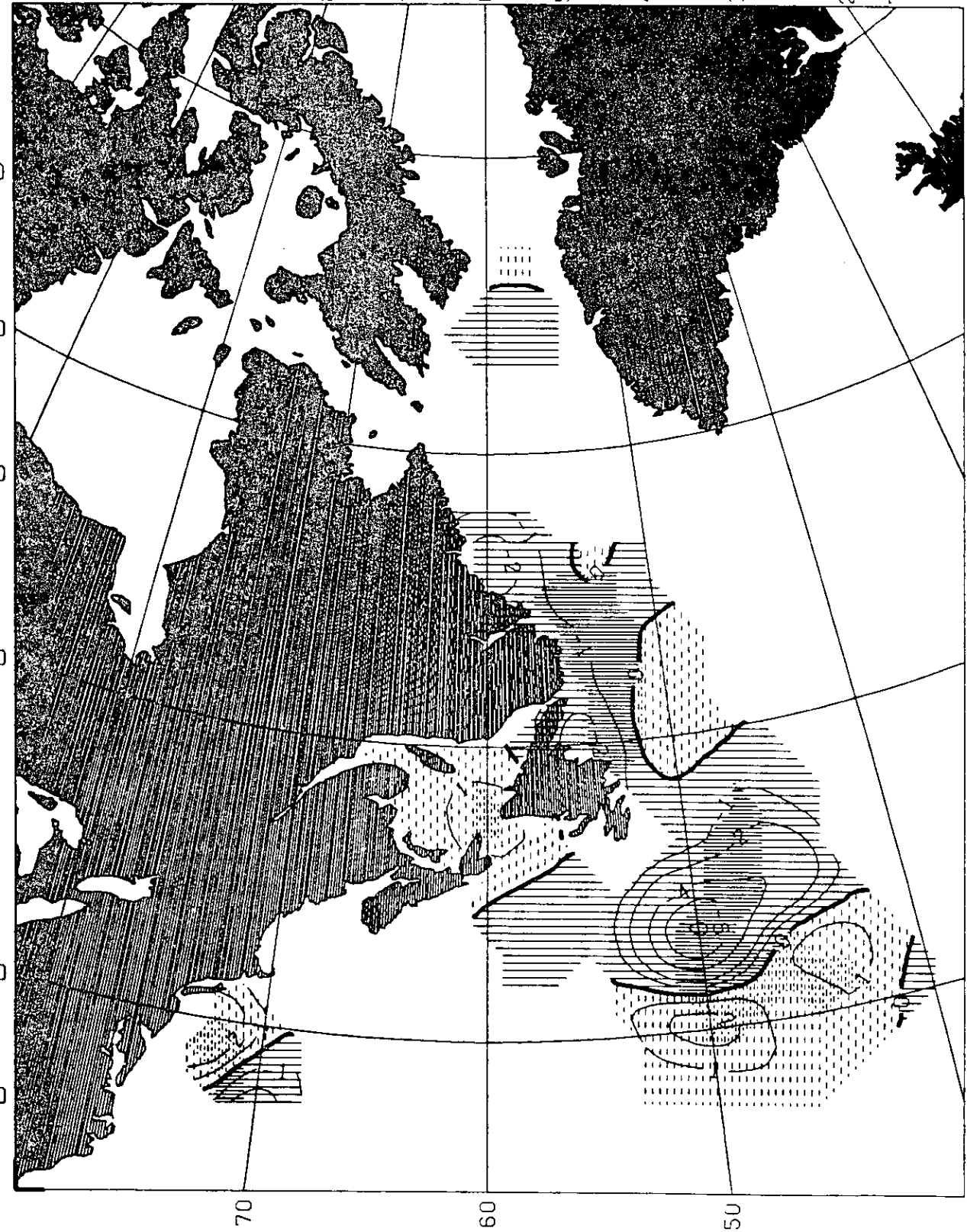
TEMPERATURE ANOMALY (DEG C) IN OCTOBER AT 250 M.

TEMPERATURE ANOMALY (DEG C) IN OCTOBER AT 500 M.



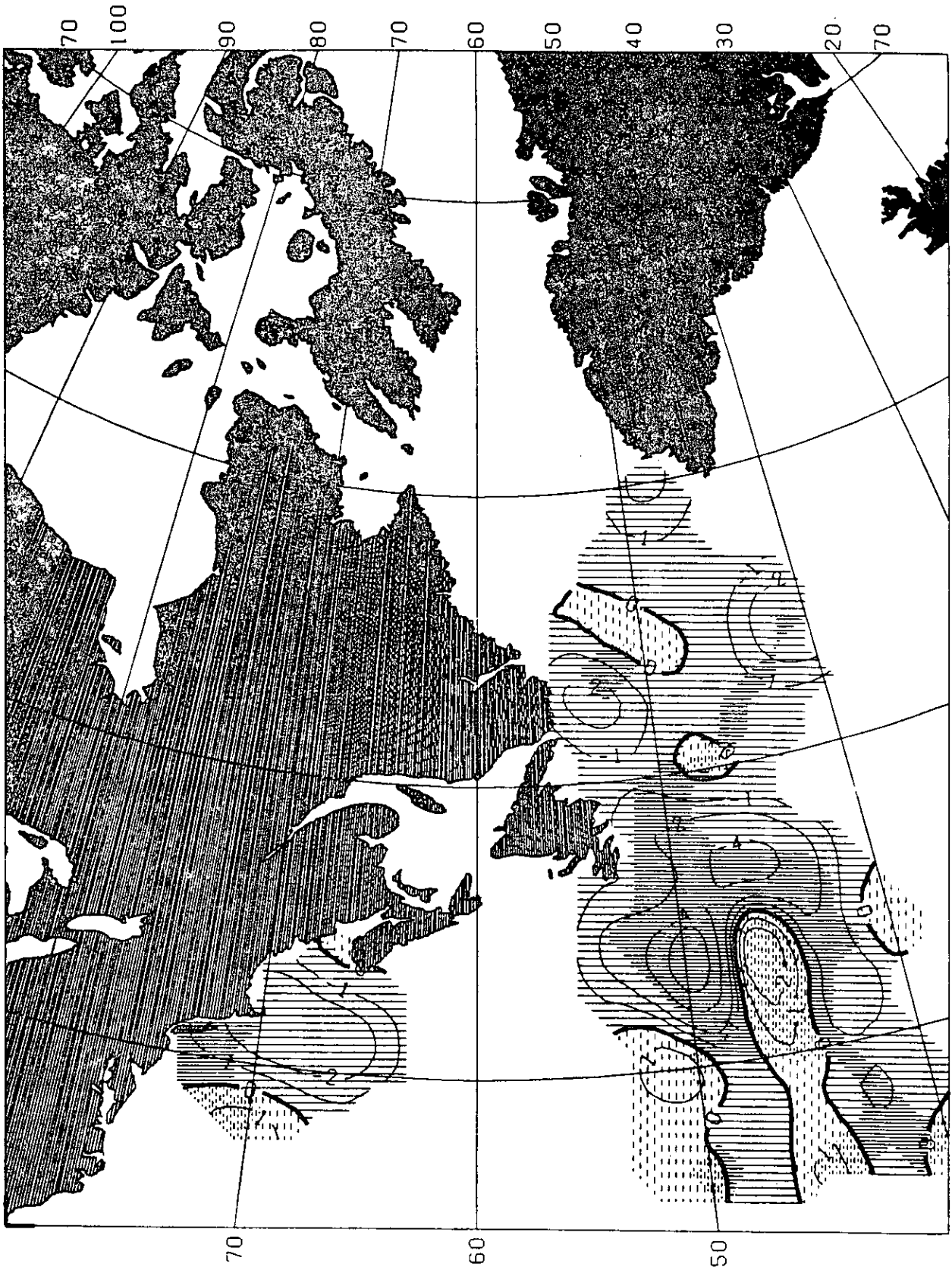
TEMPERATURE ANOMALY (DEG C) IN NOVEMBER AT 0 M.

TEMPERATURE ANOMALY (DEG C) IN NOVEMBER AT 100 M.



TEMPERATURE ANOMALY (DEG C) IN NOVEMBER AT 250

TEMPERATURE ANOMALY (DEG C) IN NOVEMBER AT 500 M.



TEMPERATURE ANOMALY (DEG C) IN DECEMBER AT 0 M.

TEMPERATURE ANOMALY (DEG C) IN DECEMBER AT 100 M.

TEMPERATURE ANOMALY (DEG C) IN DECEMBER AT 250 M.

TEMPERATURE ANOMALY (DEG C) IN DECEMBER AT 500 M.