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Again Warm Water off West Greenland

by

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Introduction

The hydrogaphic conditions off West Greenland are mainly influenced by two water masses: The polar component of the cold and fresh East Greenland Current and the warm and haline component of the Irminger Current which is a branch of the Gulfstream Current system (fig. 1). Off West Greenland this "warm water heating" led to ice-free coastal zones off Southwest Greenland whereas the cold Labrador Current caused the severest ice-winter 1984/85 off the Canadian coast since 1972 (fig. 2). As shown by STEIN and BUCH (1985) strong negative anomalies of temperature and salinity since 1981 which yielded a maximum during 1983 are explained due to variations of the East Greenland component of the West Greenland Current system, and due to regional meteorological anomalies. STEIN (1985) noted that the two coldest periods in over 20 years on Fyllas Bank (triangle in fig. 1) occurred in 1972 and 1983, at times when strong El Nino-type events occurred in 2 successive years in the South Pacific Ocean. He suggested that the linkage is through large-scale atmospheric circulation. DICKSON et al. (1984) attempted to trace the progress of the anomalous cooling and freshing of the North Atlantic using the circulation scheme of DIETRICH et al. (1975). According to their results the cool fresh conditions were exported to the open North Atlantic, principally via the expanded East Greenland Current (fig. 3).

The Data

West off Fyllas Bank at 63°53'N, 53°22'W (fig. 1), the Institut für Seefischerei, Hamburg, and the Greenland Fisheries- and Environmental Research Institut, Copenhagen conducted regular observations on the physical oceanographic environment of the waters, mostly in conjunction with biological programs. These data, starting in 1963, are used to analyse the climatic situation of the West Greenland waters during the autumn season. For further details on the data base the reader is referred to STEIN and BUCH (1985).

Discussion

The largest heat input to this area occurs via the Irminger component of the West Greenland Current having its maximum of intensity during autumn, whereas the temperature minimum is found mostly during February (BUCH, 1982). From the beginning of the time series in 1963 only positive temperature values were recorded until 1981 between the sea surface and the bottom. 1982, for the first time, negative temperatures were found in the surface layer, a trend which continued 1983 and 1984. Fig. 4 displays the mean temperature and salinity anomaly of the surface layer 0-200 m from 1963 to 1985. Within this layer temperature and salinity varies considerably during time. As a means to trace the variation, the ratios s/T or s/S are analysed, with s being the standard deviation of T,S and T, S the mean temperature/salinity at standard depths. Whereas in the top 50 m this ratio amounts to more than 70 % (T)/1.6 % (S) it is less than 20 % (T)/1 % (S) below 200 m water depth. These changes are inferred to the surface layer by various processes. The thermohaline structure is mainly influenced by the seasonal periodicity of the two current components (BUCH, 1984) as well as by the discharge of icebergs, the formation of sea-ice, the wind stress (STEIN, 1985) and the seasonal variation of the solar radiation.

As shown in fig. 4 several phases of cooling and warming were recorded since 1963. The duration and intensity of the cooling, observed from 1981 throughout 1984, is, however, unique within the 23 years of observations. The warming within the upper 200 m of the water column indicated already by 1.1°C in the 1984 data, continued during the 1985 observations which result in 0.6°C above normal. Normal within this context is 2.6°C for the 0-200 m layer.

A mild winter 1984/85, a warm summer 1985, and a mild autumn 1985 contributed to a warming of the surface layer at the NAFO Standard Oceanographic Station No. 4 of the Fyllas Bank section.

However, also below this layer a warming was observed. Within the core of the Irminger component of the West Greenland Current which is found between 400 m and 500 m depth, the 1985 temperatures amounted up to 5.6°C. This value exceeds those from the two previous years by 0.8°C. In the diagram of the mean salinity anomaly two periods are marked which coincide with those given by DICKSON et al. (1984). The 1969-70 period, where peak cooling and freshening appear to have passed along the West Greenland Banks, and the recently observed freshening of the waters off East Greenland (DICKSON et al., 1984; DICKSON and BLINDHEIM, 1984) point at a chain of advective processes which take place in the North Atlantic Current system. Do such drastic events of cooling and freshening influence fish stocks off West Greenland?

The fact that during 1983 and 1984 massive emigrations took place to East Greenland and Iceland led to a dramatic decline of the yield of the successive years, where the TAC's could not be fished completely. This trend is also visible in the reduced CPUE's of these years. The 0-group of cod, first observed during the 1984 autumn survey, was found during the next years autumn survey as strong I-group. Favourable environmental conditions and an appropriate offer of food resulted in a strong year class 1984. Also the 1985 cod year class was observed in large quantities during the 1985 autumn survey. The 1986 survey will show whether it is as successful as the 1984 cod year class.

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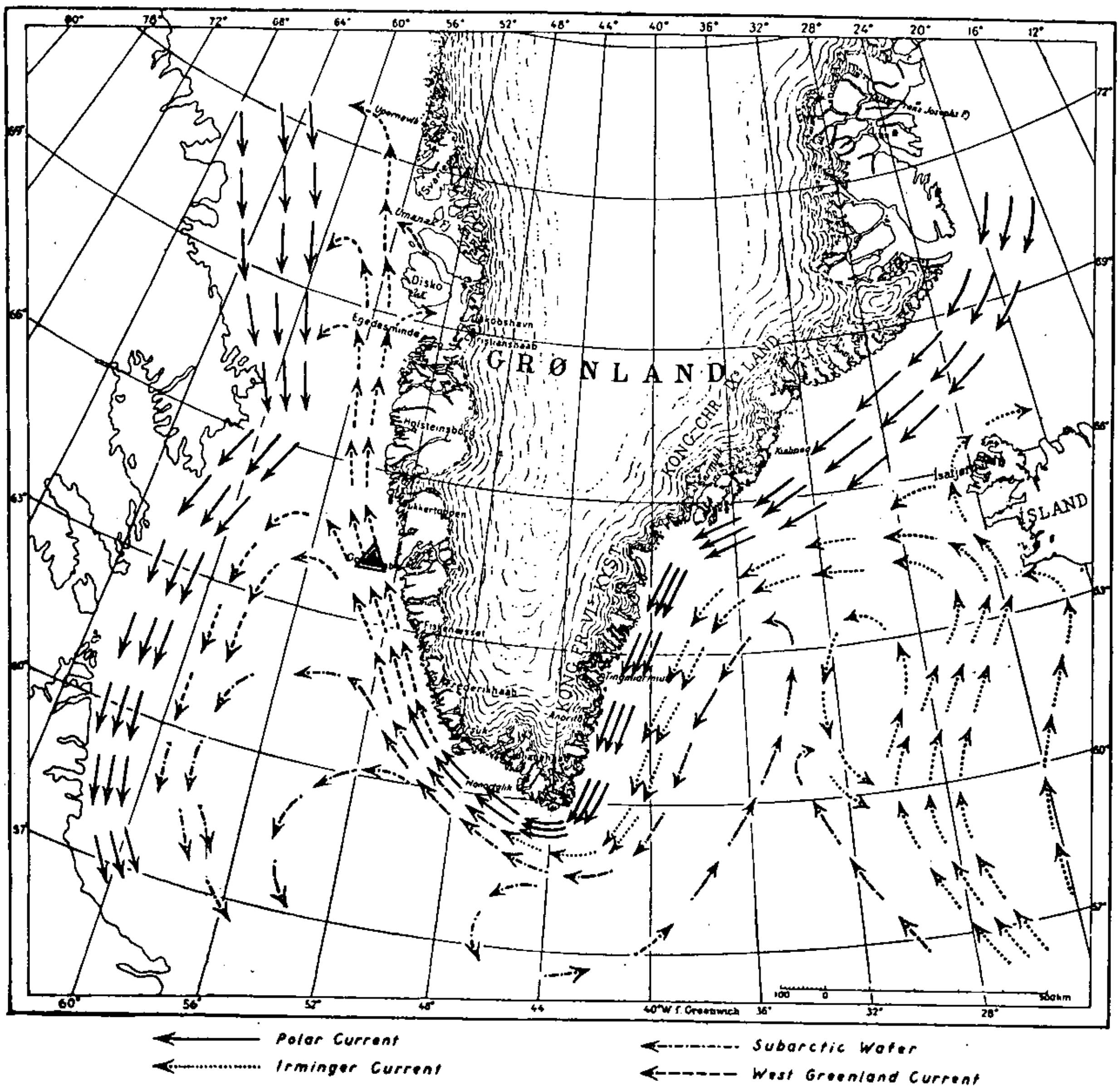

Fig. 1: Surface currents in Greenland waters; Triangle: Oceanographic Standard Station 4 off Fylla Bank. (from HANSEN and HERMANN: Fisken og Havet ved Grønland)

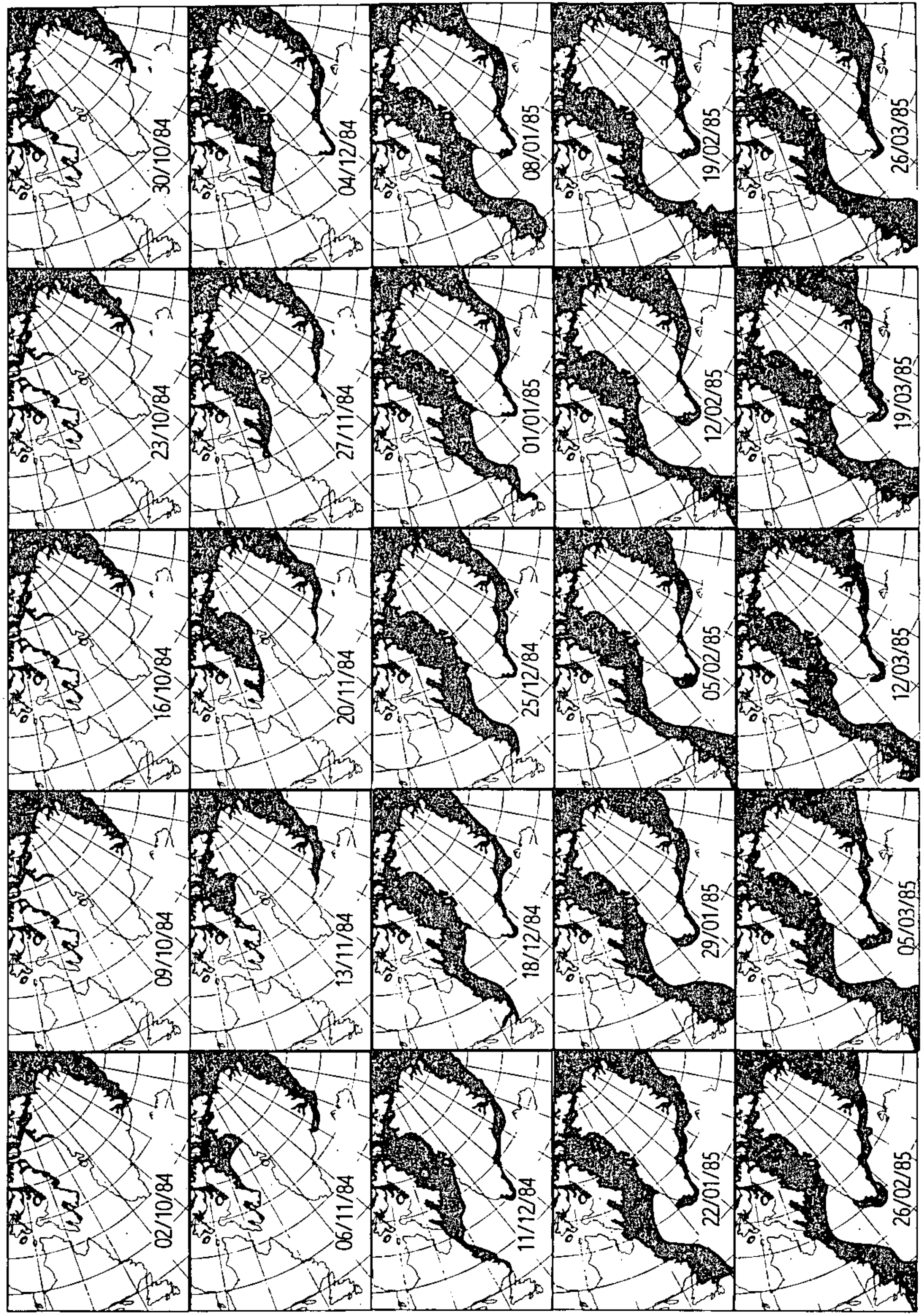

Fig. 2: Ice cover in Greenland and Canadian waters (Oct. 1984 to March 1985)

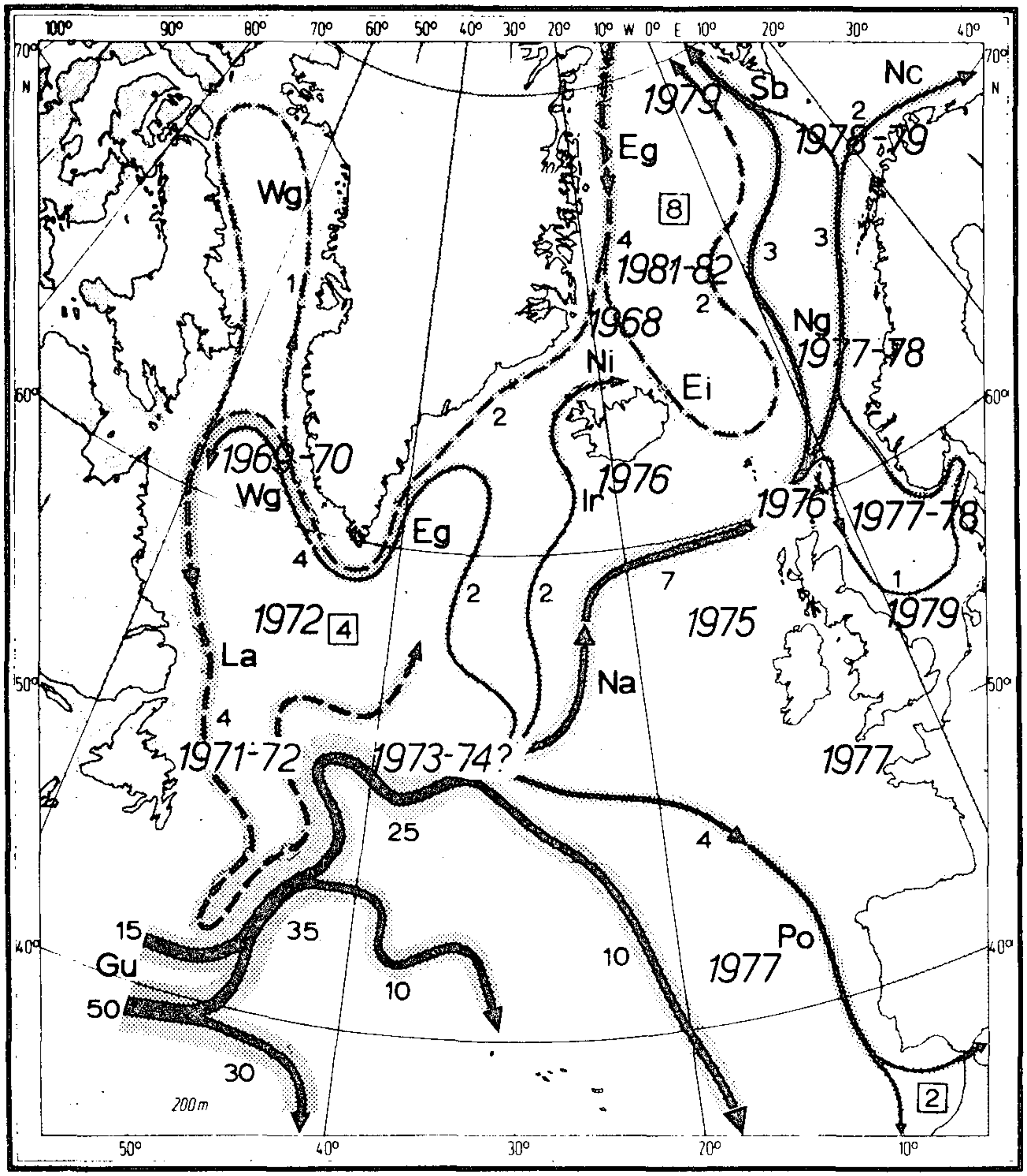

Fig. 3: Transport scheme for the 0-1000 m layer of the northern North Atlantic (DIETRICH et al., 1975) with the dates of the salinity minimum superimposed (from DICKSON et al., 1984)

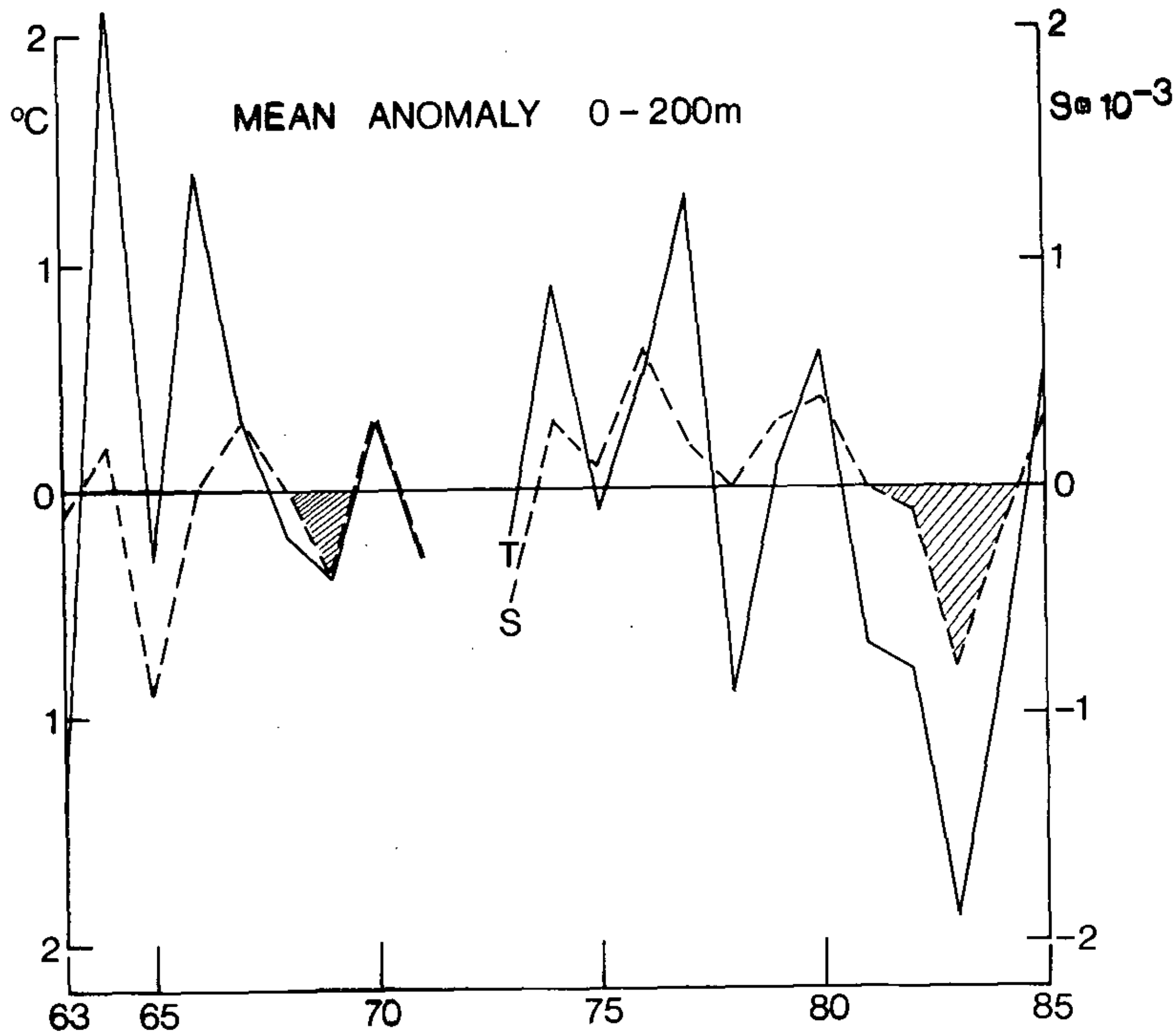

Fig. 4: Mean temperature and salinity anomaly of the surface layer 0-200 m at NAFO Oceanographic Standard Station 4