## 3.3 Water temperature fluctuations in the marginal zones of the Svjataya Anna and Voronin Troughs.

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### Introduction

Within the framework of the joint Russian-German expedition 2001 onboard of the RV "Academik Boris Petrov" the measurements of water temperature and salinity using CTD-sonde "Neil Brown-MKIII" were executed. In the northern and northwestern parts of the investigated area of the Kara Sea the significant water temperature fluctuations and inversion layers within the upper layer were observed (Fig. 3.16).

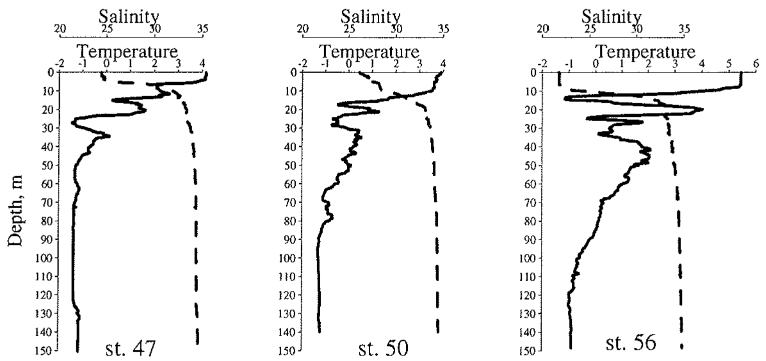


Fig. 3.16. Vertical distribution of the water temperature and salinity

Review of the hystorical data has shown that the similar thermohaline structure (more or less strong) was observed in this region in previous years. Thus the such phenomenon is not the feature of the summer 2001 but it is a feature of the investigated area represented the marginal zones (peripheries) of the Svjataya Anna and Voronin Troughs with depths about 100-150 m. In the present paper we will try to give some explanation of this phenomenon based on the observations of the cruise in summer 2001.

### Discussion

The first possible reason of this phenomenon (and the easiest to explanation) is the spreading of some water masses into the Kara Sea from the Arctic Basin through the Svjataya Anna and Voronin Troughs or through the strait between the Novaya Zemlya and Franz-Iosif Land. Yes, indeed, we observed the layer of Arctic Basin Surface Water at the northern and northeastern CTD-stations below the pycnocline at 25-35 m water depth. The temperature of this water is about 0.2-0.5 °C less than temperature of the underlying Deep Kara Sea Water. And usually, it is marked the influence of the warm Atlantic Water and Barents Sea Water in this region (but not in the upper water layer). Anyway, this influence must be more or less permanent in the time and space.

During the water sampling at the stations several casts were executed usually. The time intervals between the casts were about 1-2 hours. In Figure 3.17 the temperature vertical distributions at the CTD-stations are presented. It is easy to see the strong temporal variability of the temperature.

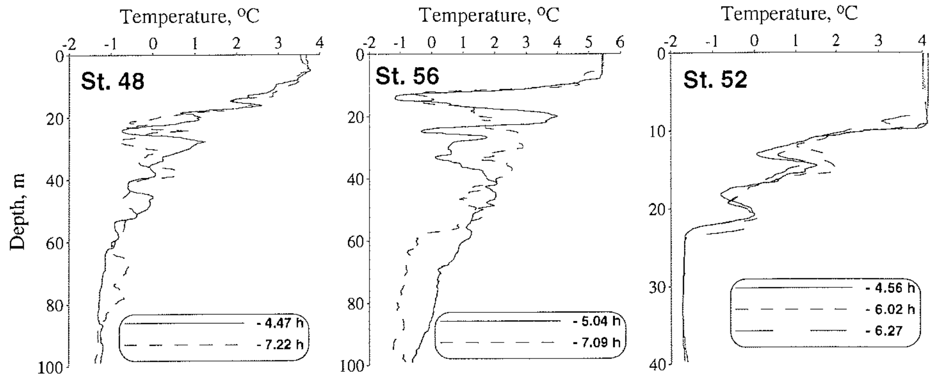


Fig. 3.17. Temporal variability of the temperature vertical distribution.

In Figure 3.18 the vertical distribution of the temperature in the upper water layer at the short section (stations 48, 49, 50) is presented. The spatial intervals between these stations are 1-2 navy miles. Also it is easy to see the strong spatial variability of the water temperature. Thus the temperature fluctuations not caused by the influence of some water masses but only by the influence of some dynamic processes.

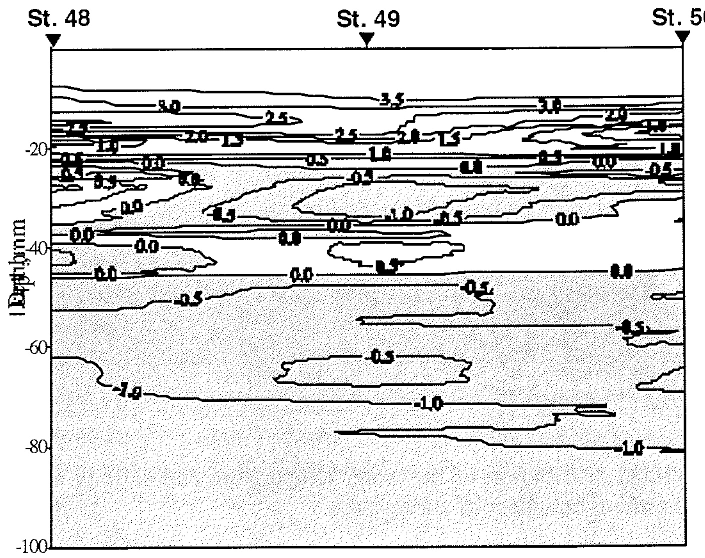


Fig. 3.18. Vertical distribution of the water temperature at the section.

For consideration we have following positions: 1). The temperature fluctuations take place in the zone of bottom rising (at the depths 100-150 m). At the deepest stations of survey area (st. 46 and 34) some temperature fluctuations are absent. 2). During the summer cruise 2001 the section along the northern boundary of the investigated area was executed (Fig. 3.19). In contrary to the salinity the temperature distribution is quite strange. There are alternating cores of the more cold and more warm water. At the all sections in the investigated area there is similar picture (for example, Fig. 3.18). 3). The layer of cold Arctic Basin Water is an initial reason of temperature uniform structure. 4). At the all stations with temperature fluctuations we have the strong seasonal pycnocline and all fluctuations take place under it or/and in the lower part of pycnocline at the depths 10-60 m.

So we propose the following explanation of the observed phenomenon. The specific topography in the marginal zones of the troughs promotes the strong amplification of the internal waves. The strong pycnocline limits the growth of the wave amplitude and contributes to wave breaking. The existence of unstable layers (Fig. 3.20) confirms it.

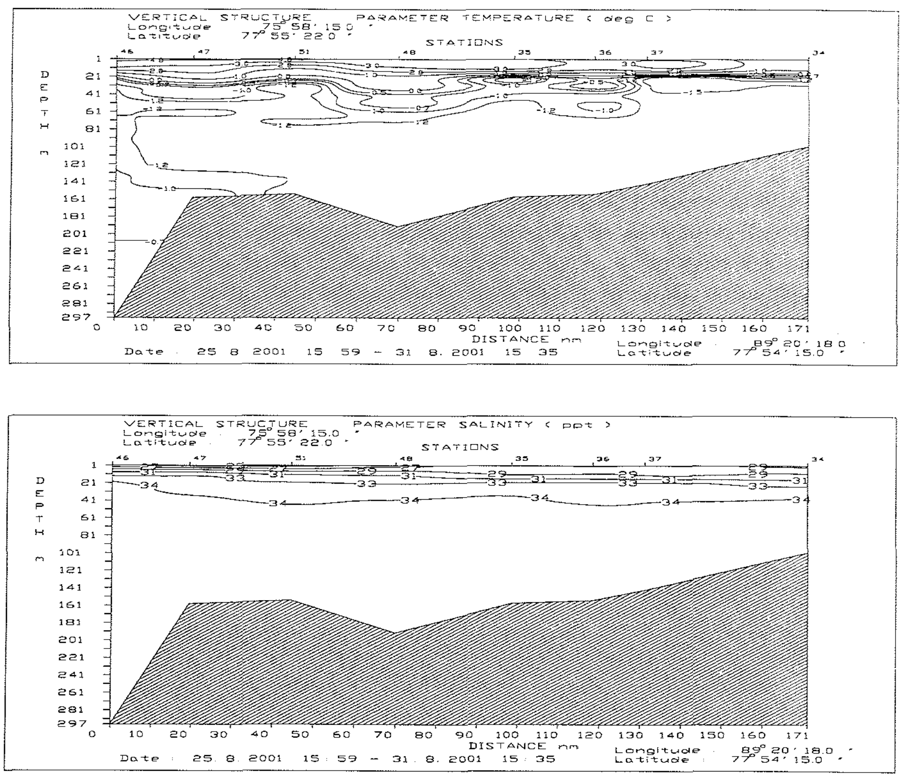


Fig. 3.19. The vertical distribution of the water temperature and salinity at the section along the northern boundary of survey area.

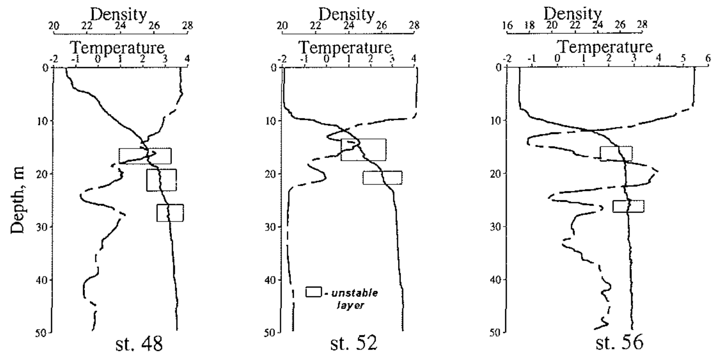


Fig. 3.20. The vertical distribution of the temperature and density

At the several stations with the investigated phenomenon the CTD-sonde was deployed within the layers with the temperature peculiarities during of about 1 hour. Unfortunately, the measurements were executed only at the one horizon. The analysis of these measurements has shown the very significant temperature oscillations and the difference between the main periods of the temperature and salinity oscillations (Fig. 3.21-3.23). It is necessary to mark that short-period waves are observed on the background of the more long-period (0.5-1 hour) waves. Also it is very possible that at the station 56 (Fig. 3.21) we observed the breaking of the internal waves at the measurement horizon.

**Conclusion**

The topographic amplification of the internal waves is a main reason of the significant water temperature fluctuations and inversion layers within the upper layer in the marginal zones (peripheries) of the Svjataya Anna and Voronin Troughs.

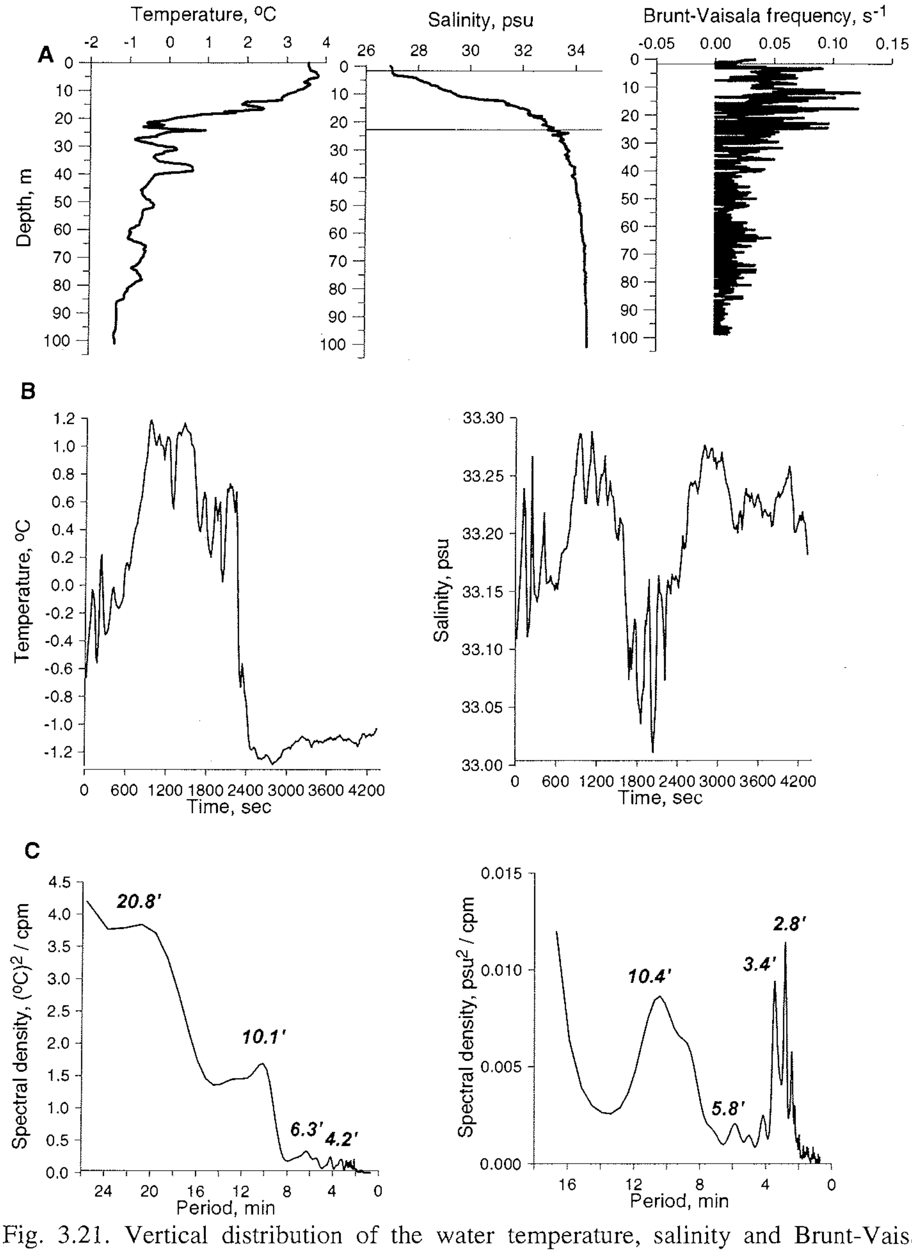


Fig. 3.21. Vertical distribution of the water temperature, salinity and Brunt-Vaisala frequency (A), oscillations of the temperature and salinity at the horizon 22.7 m (B) and spectra of these oscillations (C). Station No 48

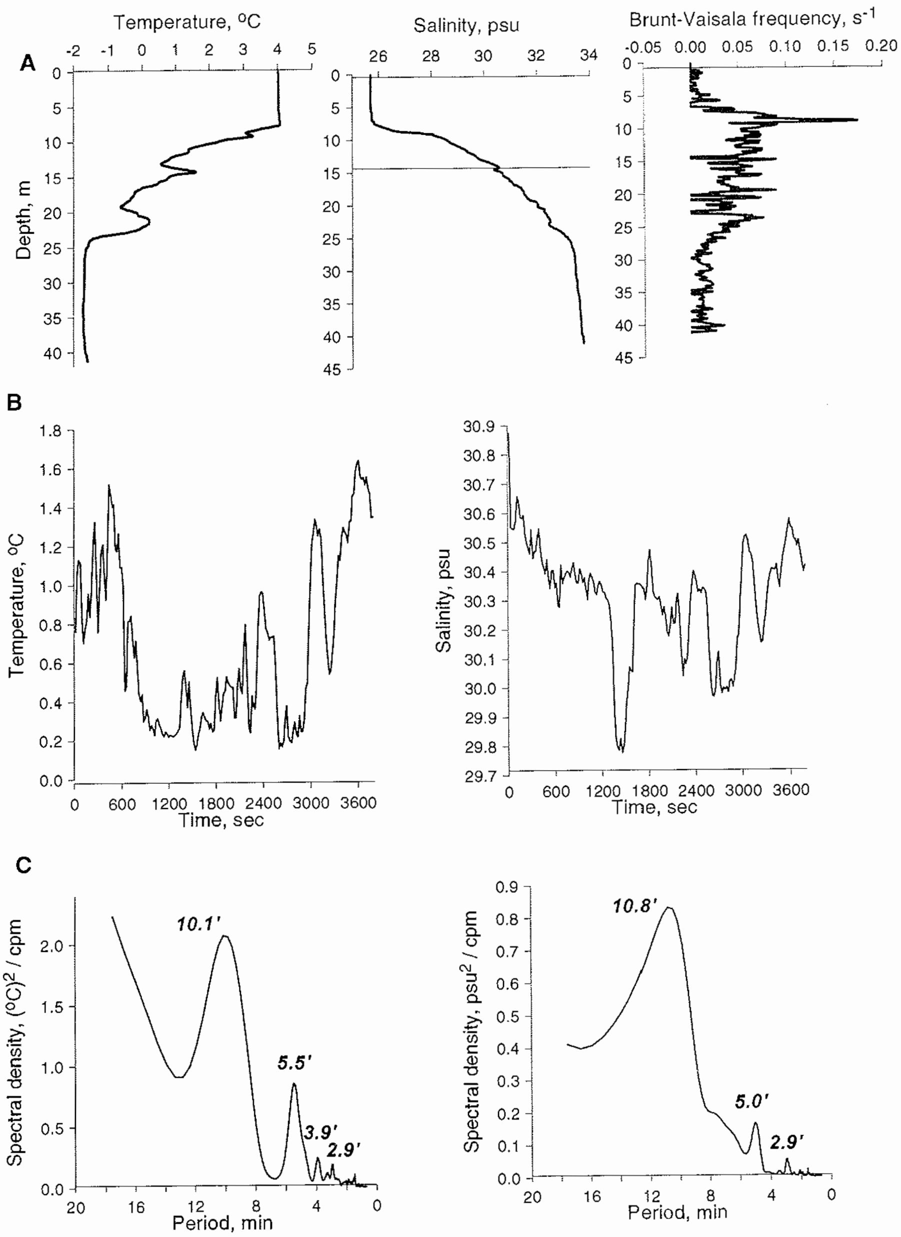


Fig. 3.22. Vertical distribution of the water temperature, salinity and Brunt-Vaisala frequency (A), oscillations of the temperature and salinity at the horizon 14.3 m (B) and spectra of these oscillations (C). Station No 52.

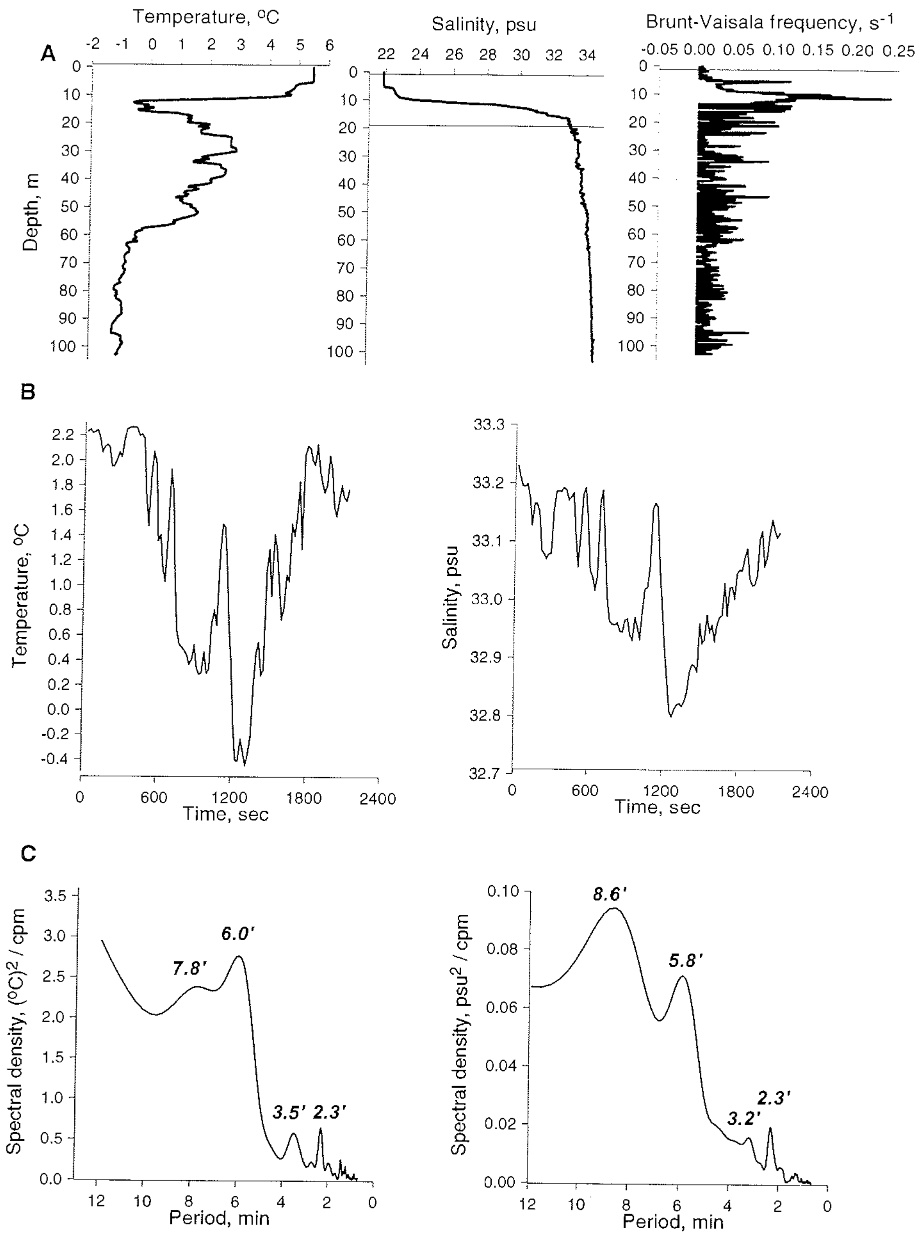


Fig. 3.23. Vertical distribution of the water temperature, salinity and Brunt-Vaisala frequency (A), oscillations of the temperature and salinity at the horizon 19 m (B) and spectra of these oscillations (C). Station No 56.