

Composition of recent bottom sediments of the Chukchi Sea. Results of an integrated sedimentological research

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ABSTRACT. Results of high-resolution research of recent bottom sediments from south, central and north Chukchi Sea reveal striking data on environmental changes during the last decades. The composition of surface sediments from the Arctic Sea gives evidence of the decrease of ice cover and an increase of biogenic elements, caused by higher bioproductivity.

Keywords: Chukchi Sea, bottom sediments, recent sedimentation rates, grain size, biogenic components

1. Introduction

Recent climate changes cause serious concern of scientists and the public for the development of the environment. The Arctic is one of the most sensitive regions and especially susceptible to the effects of global warming. In this regard, the importance of studying recent sedimentation in the Arctic seas in general and in the Chukchi Sea in particular is continuously growing.

2. Material and methods

Three cores of surface sediments from the south (LV83-1-2), central (LV77-5-2) and north (b16) region of the Chukchi Sea were taken by boxcorer and multicorer from «RV Professor Khromov» (2012) and «RV Academician M.A. Lavrentiev» (2016, 2018) (fig.1, table 1). They were described by smear slides and analyzed for magnetic susceptibility (MS), grain size, biogenic silica ($\text{SiO}_{2\text{bio}}$), organic carbon (C_{org}), total nitrogen (N_{tot}), diatom and palynological analyzes. Dating of cores was carried out by ^{210}Pb and ^{137}Cs measurements (Astakhov et al., 2019; Vologina et al., 2019).

3. Results and discussion

All sediments show a fairly uniform grain size distribution. In the cores, silt predominates (79–91 %). Clay content varies from 6 to 19 %, whereas content of sand never exceeds 7 %.

Minimum MS values have been determined in the uppermost 2 cm of all three cores (LV83-1-2, V77-5-2 and b16). Core b16 shows maximum values of up to $42 \cdot 10^{-6}$ SI units within its lower half.

The contents of C_{org} and N_{tot} average 1.45 % and 0.18 % in core LV83-1-2, 1.63 % and 0.21 % in core LV77-5-2, and 1.73 % and 0.21 % in core b16. The upper parts of all three cores show increased concentrations of the biogenic components $\text{SiO}_{2\text{bio}}$, C_{org} and N_{tot} . Core b16 has higher content of $\text{SiO}_{2\text{bio}}$ (11.1–16.0 %) than the cores LV83-1-2 (4.51–6.83 %) and LV77-5-2 (1.71–6.36 %). The molar C/N ratios of core LV83-1-2 vary from 6.4 to 7.9, of core LV77-5-2 from 5.8 to 7.7 and core b16 from 8.8 to 9.9. These C/N values indicate the prevalence of autochthonous planktonic organic matter.

Sedimentation rates of cores b16 and LV77-5-2, calculated from ^{210}Pb and ^{137}Cs measurements and LV83-1-2, according to (Baskaran and Naidu, 1995) are shown in table 1. Core LV77-5-2 from the central part of the Chukchi Sea exhibits two peaks of ^{137}Cs activity in the sediments. One of them is associated to the accident at the Chernobyl nuclear power plant in 1986, whereas the other represents the accident at the Fukushima nuclear power plant in 2011 (Vologina et al., 2019). Older sediments have been determined within the northern part of the Chukchi Sea (core b16), where sediments of the Little Ice Age (LIA) were detected. They show very low concentrations of $\text{SiO}_{2\text{bio}}$, C_{org} , N_{tot} and concurrently high contents of the cold-water diatom species *Thalassiosira antarctica* (Astakhov et al., 2019; Vologina et al., 2019).

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Table 1. Number, length, coordinates, area, year of sampling, water depths and sedimentation rates of cores of the Chukchi Sea

number	length [cm]	coordinates	area of Chukchi Sea	year of sampling	water depth, [m]	sed. rate [mm y ⁻¹]
b16	37	72°32'37.8" N 175°59'42" W	North	2012	100	0.9–1.3 (Vologina et al., 2019)
LV77-5-2	20	69°42'39.7" N 173°11'59.5" W	Central	2016	50	2.5–2.7 (Vologina et al., 2019)
LV83-1-2	35.5	67°29'27.5" N 170°56'18.4" W	South	2018	50	1.4–2.7 (Baskaran and Naidu, 1995)*

* sedimentation rates in the area of position of core LV83-1-2

The palynological composition of the sediments of the three cores reflects in general tundra and forest-tundra conditions on the land, adjacent to Chukchi Sea. The presence of coniferous pollen and re-deposited Neogene myospores is due to river input, wind drift from the coasts and influx by currents from the Bering Sea.

4. Conclusions

The composition of surface sediments of the Chukchi Sea reflects considerable changes in the natural environment during the recent, warmer decades and differs distinctly from the cooler conditions during LIA. They are caused by an increase of the inflow of warm Pacific waters through the Bering Strait (Woodgate, 2018), a decrease in arctic ice cover (Astakhov et al., 2019) and a change in the redox conditions of bottom waters after 1980 (Bunzel et al., 2016). In summary this leads to an increase of bioproductivity within the water and higher concentrations of biogenic elements in the uppermost sediment layers of the Chukchi Sea.

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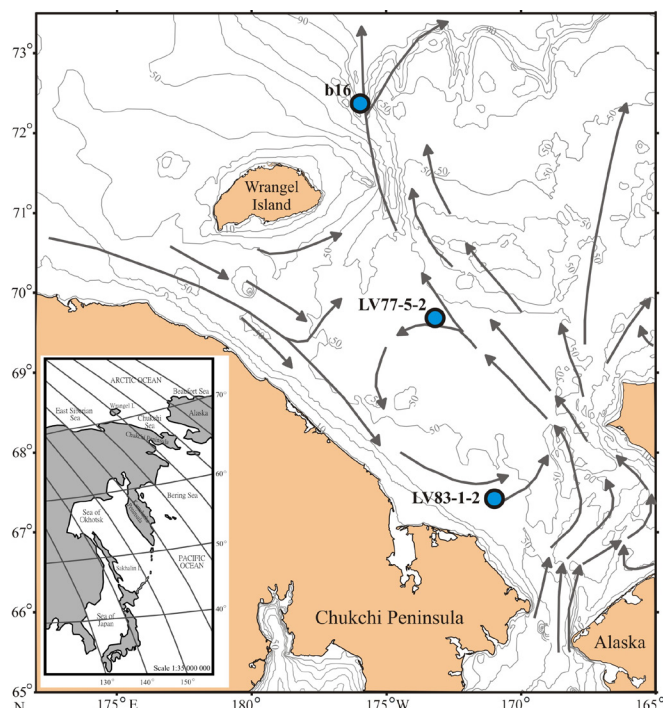


Fig.1. Map of Chukchi Sea with the positions of cores LV83-1-2, LV77-5-2 and b16. The arrows mark main water currents within Chukchi Sea (according to (Grebmeier et al., 2006)).

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