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Sedimentation in the Western Baltic Sea as recorded in the sediment core from the Arkona Basin

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The Arkona Basin, situated in the westernmost part of the Baltic Sea, underwent a specific Late Glacial and post-glacial evolution reflected in the layers of bottom sediments. The lithostratigraphy of the representative section PSh-5441 of this basin (at a depth of 46 m) was established based on the results of the sedimentological analysis and radiocarbon (^{14}C) dating. Spores–pollen spectra were used for biostratigraphy, while diatom analysis was carried out to evaluate the sedimentary environment.

The sediment section from the northern part of the Arkona Basin consists of the Late Glacial and post-glacial clays and silts which accumulated after territory deglaciation. Layers of brown and grey clays separated from each other by sedimentation hiatus had been developing under very changeable sedimentation conditions which could exist in the shallow basin at the end of the Baltic Ice Lake stage and in the later period. This time of development is marked by active processes of re-deposition. During the Litorina Sea stage two phases of sedimentation are distinguished. In the first phase, the water salinity was rather high and sedimentation took place under sub-littoral environmental conditions. In the second phase, it was possible to observe a slight raise of water level, and water salinity slightly increased as well. Sedimentation took place in the shallow sea.

Key words: lithostratigraphy, spores and pollen, diatom flora, ^{14}C dating, sedimentation environments, Baltic Sea

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INTRODUCTION

The Late Glacial and post-glacial evolution of the Baltic Sea is well reflected in the composition of the sea bottom sediments (Agrell, 1979; Ignatius et al., 1981; Eronen, 1988; Björck, 1995; Блажчишин, 1984; 1998 and others). Sediment sections from the various regions (Kalm et al., 1996; Sohlenius et al., 1996; Heinsalu et al., 2000; Winterhalter, 2001; Емельянов и др., 1995; 2001 and others) show that in every sea basin sedimentation processes were proceeding differently because of morphological properties of the bottom relief, peculiarities of water dynamics, sources of sedimentary matter and other causes. In one of such regions – the Arkona Basin situated in the westernmost part of the Baltic Sea – significant traces of the reaction between the sea and the ocean had to be reflected best in the compositional changes of sediment (Jensen et al., 1997, 1999; Lemke et al., 2001; Moros et al., 2002 and others).

The level of the Baltic Sea changed many times after the recession of the glacier. An abrupt and considerable (about 25 m) fall of the water level happened at the end of the Baltic Ice Lake stage (Svensson, 1991; Björck, 1995). This event made a great impact on the entire Baltic Sea basin and undoubtedly affected the course of sedimentation in the Arkona Basin. During later sea stages, environmental changes caused by water level fluctuations were happening on a smaller scale. However, the reflection of these changes is noticeable in the Arkona Basin as well, though with different effects. The more considerable differences of sedimentation processes in the Holocene were determined by a new connection that appeared between the North Sea and the Baltic Sea via the Danish straits going almost straight into the Arkona Basin. It happened after the isolation of the Baltic Sea during the Ancylus Lake stage (Agrell, 1979; Björck, 1995; Lemke et al., 2001; Berglund et al., 2005; Christensen, 2005). Since that time till now, there exists water exchange between the Baltic Sea and the ocean (the North Sea), and water level fluctuations have affected the sedimentation processes in the Arkona Basin much earlier and stronger than in other Baltic Sea basins.

Detailed sedimentological, geochemical (Emelyanov, 1995; Gingele, Leipe, 1997; 1998; Sohlenius et al., 2001), palaeontological (Lange, Wulff, 1980; Клейменова и др., 1984; Лукошявичюс, 1985; Yuspina, 2005) and combined lithostratigraphical and seismoacoustical investigations (Jensen et al., 1999; Moros et al., 2002) showed a rather complicated palaeogeographical history of the Arkona Basin. According to new data interpretation, seven lithostratigraphical units are distinguished (Moros et al., 2002), which are correlated with the well-known Baltic Sea stages. One more study, devoted to the analysis of the Baltic Sea evolution (Kortekaas, 2007), showed that the bounds and age of the Baltic Sea stages determined by ^{14}C and OSL methods noticeably differ. Thus, there is a reason, with the help of new data, to consider it in order to deepen our knowledge about the formation of the sediment cover in the Arkona Basin.

MATERIALS AND METHODS

The new results of the study of the sediment section PSh-5441 are presented. The samples were taken by the authors of this paper from the Arkona Basin in 2005 during the 70th expedition of the r/v "Professor Shtokman". The coordinates of the sediment core are the following: 55°06.686' N, 13°36.477' E. The sea depth at the sampling site is 46 m (Fig. 1).

The initial detailed description of sediments and the lithostratigraphic subdivision of the section were complemented by the ^{14}C sediment dating method (three samples). The later works were performed by Radiocarbon Laboratory of the Environmental Geochemistry Institute in Kiev, Ukraine (Table 1).

Palaeobotanical studies of 22 samples were made using the method of spores–pollen and diatom analysis.

Sediments for *spores–pollen analysis* were prepared following the standard technique (Гричук, Заклинская, 1948; Erdtman, 1960). The total calculated number of tree and herb pollen per sample reaches 900 and more grains. When the concentration of spores–pollen was very low, no less than 200 pollen grains were calculated. The calculation of the percentage of the spectrum composition was based on the sum of tree (AP) and herb (NAP) pollen (ΣAP + ΣNAP = 100%). The identification of pollen and spores was done with the aid of the "Leica" biological microscope and the use of the pollen collection and pollen atlases from the Department of Geology and Mineralogy of Vilnius University (Fægri, Iversen, 1989; Moore et al., 1991).

The chronostratigraphical subdivision of the section is based on the results of biostratigraphical investigations. The distinguished local pollen zones are correlated with the Lithuanian regional pollen zones (Kabailienė, 1990), while the latter are corre-

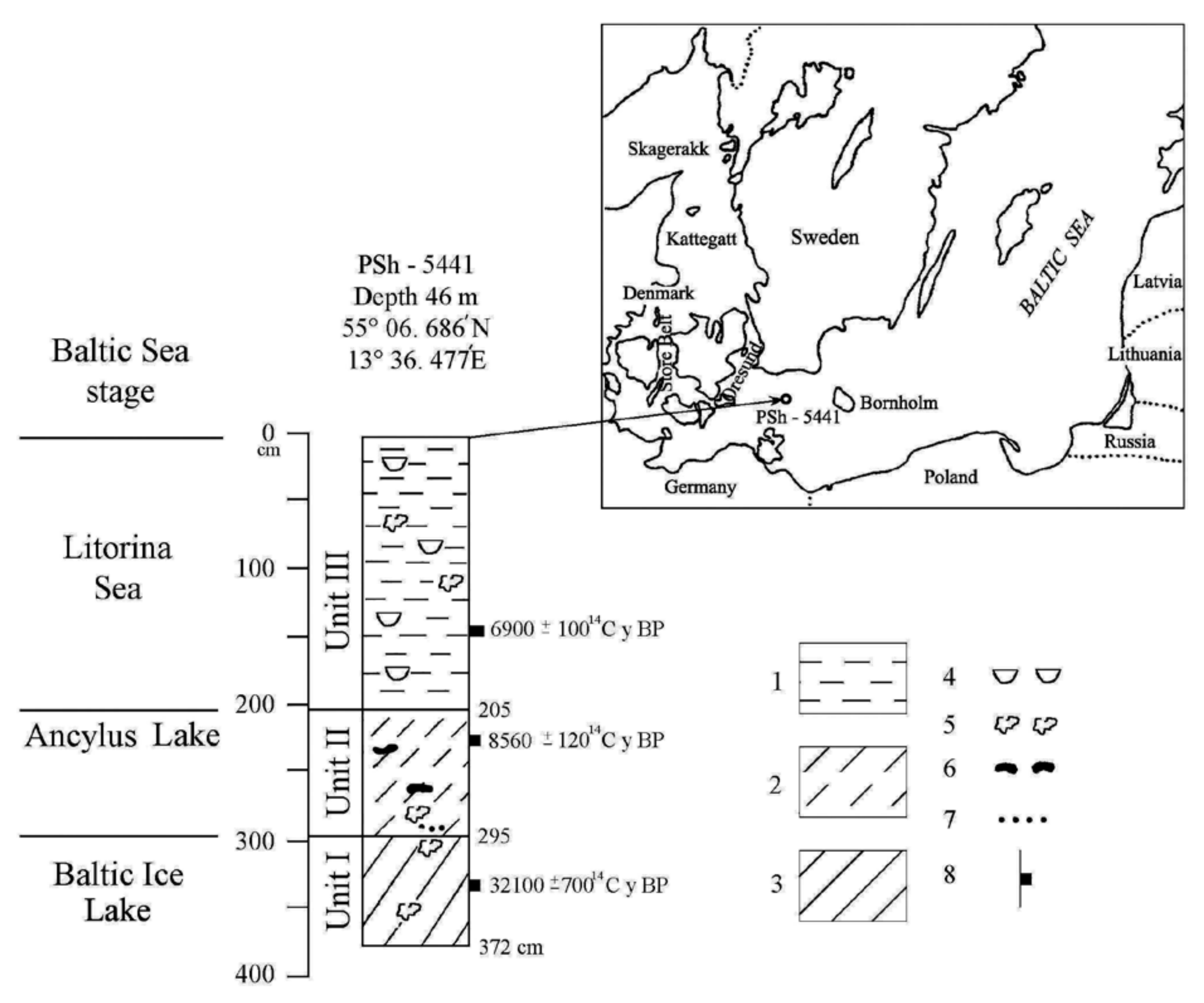

Fig. 1. Litostratigraphy and location of sediment core PSh-5441 in the Arkona Basin. Lithology legend: *1* – greenish grey mud, *2* – bluish grey clay, *3* – light brownish clay, *4* – shells, *5* – patches, *6* – black sulphide spots and lenses, *7* – sand, *8* – ^{14}C dated intervals

1 pav. PSh-5441 nuosėdų kolonėlės litostratigrafija ir vieta Arkonos duburyje. Litologija: *1* – žalsvai pilkas dumblas, *2* – melsvai pilkas molis, *3* – šviesiai rusvas molis, *4* – kriauklės, *5* – dėmėtumas, *6* – juodų sulfidų dėmės ir lęšiai, *7* – smėlis, *8* – ^{14}C datavimo intervalai

Table 1. **Results of ^{14}C dating**
1 lentelė. **Radiokarboninio datavimo rezultatai**

No.	Site	Lab. index	Age ^{14}C	
			BP	BC/AD
1.	PSh-5441, 145–150 cm, sediment	Ki-14285	6900 ± 110	1σ 5560–5360 BC 2σ 5640–5250 BC
2.	PSh-5441, 220–228 cm, sediment	Ki-14286	5860 ± 120	1σ 7760–7470 BC 2σ 8000–7300 BC
3.	PSh-5441, 325–330 cm, sediment	Ki-14287	32100 ± 700	–

Table 2. **Lithological description of the core PSh-5441 from the Arkona Basin**
2 lentelė. **PSh-5441 nuosėdų kolonėlės iš Arkonos duburio litologinis aprašymas**

Depth, cm	Sediment description	Stage of the sea
0–205	Silty-clayey mud, greenish grey, very soft. Downwards (up to 50 cm) gradually becomes firmer. Spotted mud (dotted type) lies in 50–85 cm interval. Many shell detritus and mollusc fragments are in intervals 26–27, 85–92, 175–177 cm. Small (up to 0.5–2 cm in size) oval diagenetic patches with light contours may be seen instead of dissolved shells (intervals 93–98 and 112–124 cm). Mud is relatively firm in the lower part of the interval. The lower boundary distinct (darker mud 2 cm thick)	Litorina Sea (L)
205–295	Clay bluish grey with small (dotted) black hydrotroilithic patches, moderately firm. In interval 252–262 cm, clay acquires a greenish tint. There are many small and firm sulphide nodules. In the horizon 285 cm there is a dark grey silt (sand?) lamina about 0.5 cm thick. Clay becomes mottled, patchy and moderately firm at the bottom layer (285–295 cm). The lower boundary distinct, sloping	Ancylus Lake (A)
295–372	Clay light brown, heterogeneous. In interval 360–372 cm, grey clay has a slight brownish tint, under 315 cm clay is mottled and spotted. Its density varies. The amount of lenses (carbonaceous, "dry") is increasing in intervals 295–317 and 343–360 cm.	Baltic Ice Lake (BIL)

lated with the chronozones distinguished in the West European territory (Mangerud et al., 1974).

The reconstruction of changes of vegetation is based on the immigration, expansion and flourishing of the species of trees and shrubs in the surrounding territory. The number of herb pollen provides additional information about the herb communities that were flourishing around the sediment basin.

The laboratory preparation of sediment samples for *diatom analysis* was performed following the techniques presented in sources (Battarbee, 1986). Carbonates from sediments were eliminated using hydrochloric acid, and concentrated hydrogen peroxide was used to destroy the organic matter. Because of the fact that diatoms in the sediments accumulate in the silt fraction, the clay particles were eliminated by desilting after the preliminary boiling of sediments in sodium pyrophosphate (10%) water solution. Slides for microscopic analysis were prepared using "Naphrax" tar. Slides were studied with the "Leica" biological microscope (magnification × 1000). Diatom species were identified with the taxonomic works (Krammer, Lange-Bertalot, 1986–1991).

For the purposes of description of palaeoecological conditions of the water basin, diatom species were classified into ecological groups (Van Dam H et al., 1994). According to water salinity, the following groups of diatoms were distinguished: marine – water salinity >30‰, brackish – water salinity 0.2–30‰, and freshwater diatoms. The freshwater diatom group was subdivided into three types: halophilic diatoms, which spread in an environment of very low salinity; indifferent, which reproduce best in a freshwater basin, and halophobic diatoms, which exist in a freshwater basin only (salinity <0.2 ‰). According to diatom habitat in the water basin, two groups of diatoms were distinguished: planktonic – free-floating in water mass and benthic diatoms, which live attached to various surfaces (epiphytic) or not attached (bottom diatoms) in the sub-littoral zone of the basin.

The percentage composition of spores–pollen and diatoms was calculated, and the results are presented in diagrams made using TILIA computer programs (version 2) and TILIA–GRAPH (version 2.0 b.5) (Grimm, 1991).

RESULTS

The lithological description of the sediment core PSh-5441 is given in Table 2. According to sediment composition, their structural and textural indicators and other physical parameters, the sediment section consists of three stratigraphical units (I–III) (Fig. 1).

Unit I is composed of light brown or mottled clay formed in the Late Glacial period. The intervals of 295–317 and 343–360 cm contain numerous lenses of carbonaceous ("dry") clastic material. Because of the fact that the core did not penetrate deeper bottom sediments, this unit makes a relatively thin layer. The ^{14}C age of the clay within the interval of 325–330 cm is 32100 ± 700 ^{14}C years BP. This is a very great age, presumably predetermined by a high content of sedimentary material which was washed out and brought from older Quaternary rocks exposed in the sea bottom or on the coast. These phenomena were recorded in many places of the Baltic Sea with the observation that the older were the pre-Litorina sediments the greater was

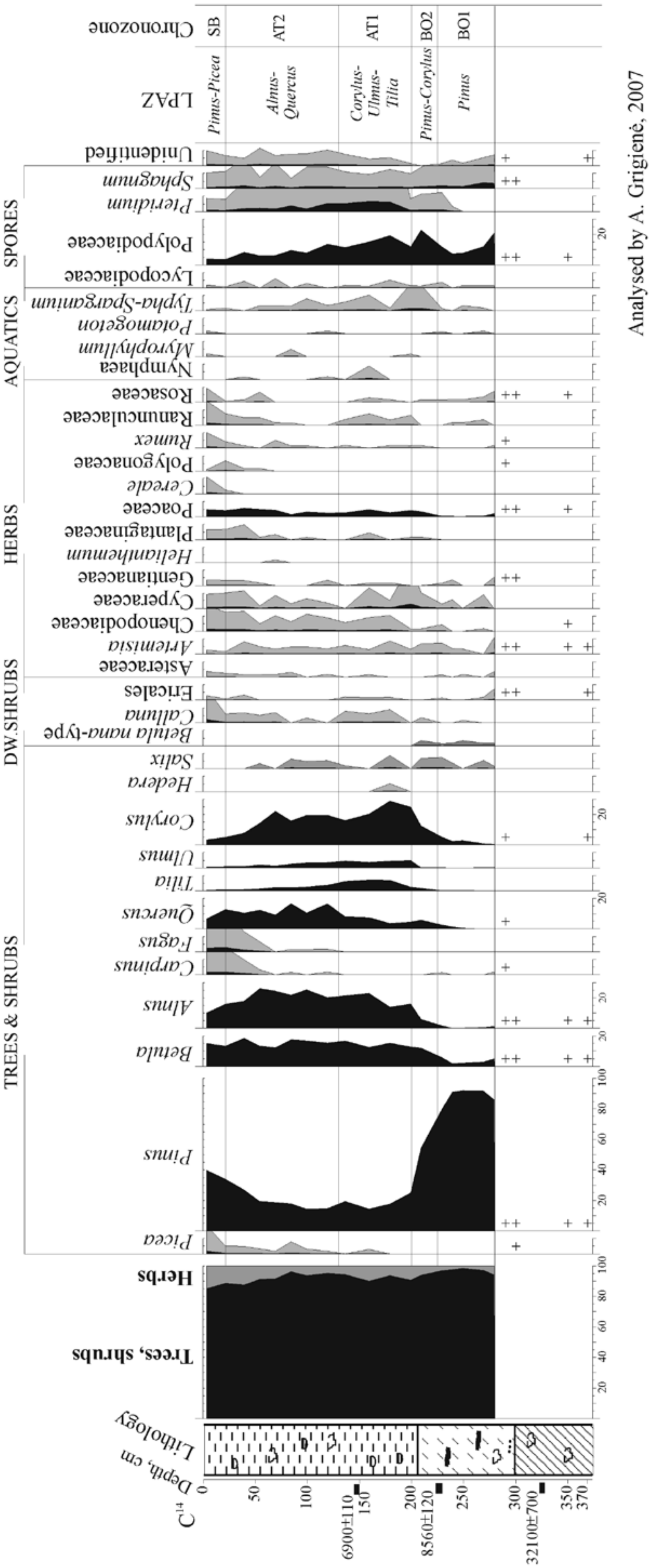

Fig. 2. Pollen-spores percentage diagram of core PSh-5441. Chronozones: SB – Subboreal, AT – Atlantic, BO – Boreal. For the lithology legend, see Fig. 1

2 pav. PSh-5441 nuosėdų kolonėlės sporų-žiedadulkių procentinė diagrama. Chronozonos: SB – subborealis, AT – atlantis, BO – borealis. Litologijos sutartinius ženklus žr. 1 pav.

the increase of the age (Емельянов и др., 2001). The assumption about the re-deposition of older material also by a relatively low density of clay is strengthened by the presence of reworked pre-Quaternary spores and pollen. Appart from these, the varved clays characteristic of many Baltic Sea deeps, including the Arkona Basin (Gingele, Leipe, 1997 and others) were not reached.

Unit II (10300–8000 ^{14}C years BP) is represented by post-glacial clays of the early Holocene is. These are layers of bluish grey, somewhere greenish, patchy and relatively thick clay. The patches are characteristic of clays because of Fe monosulphides or in some places of accumulations of small solid sulphidic aggregates (252–262 cm). The lower boundary of the grey clays is distinct and slanting, implying a stratigraphical discordance.

The ^{14}C age of sediments within the interval of 145–150 cm (Litorina mud) is 6900 ± 110 ^{14}C years BP and within the interval of 220–228 cm 8560 ± 120 ^{14}C years BP. Thus, because of the fact that the sediments within the interval of 145–228 cm accumulated during 1660 years, the sedimentation rate of mud and clay during this period (Litorina–Ancylus) could reach 50 cm/1000 years.

Sediments of unit III are represented by typical "marine Holocene" mud of the Baltic Sea. In the majority of depressions, this unit is composed of silty-clayey mud or fine silt, mainly greenish grey, microlaminated, containing a higher amount of organic carbon, and is very soft. It was accumulating after the Litorina Sea transgression (8000 ^{14}C years BP) and accumulates till now. As was already mentioned, the absolute age of the sediments within the interval of 145–150 cm is 6900 ± 110 ^{14}C years BP, so the average sedimentation rate of the Litorina mud in the Arkona Basin was 21.7 cm/1000 years.

The spores and pollen in the core PSh-5441 sediments are well preserved and their concentration is high, except four clay samples from the lower part of the section (at a depth of 288–372 cm). The spectra are predominated by tree pollen (up to 98%). In some samples, single pre-Quaternary spores and pollen were found. The spores-pollen diagram is divided into five local pollen assemblage zones (LPAZ) (Fig. 2):

zone 1 – *Pinus* (interval 225–280 cm): the spectra are predominated by *Pinus* pollen (up to 90%);

zone 2 – *Pinus–Corylus* (interval 200–225 cm): the percentage value of pine pollen decreases, whereas that of nut-tree (*Corylus*) and birch (*Betula*) pollen is increasing. The spectra of this zone contain the highest number of spores and green algae;

zone 3 – *Corylus–Ulmus–Tilia* (interval 130–200 cm): the curve of nut-tree pollen reaches 30%, lime (*Tilia*) 7%, and elm (*Ulmus*) 5%. The content of herbs, with domination of ear-forming crops (Poaceae) and sedges (Cyperaceae), increases;

zone 4 – *Alnus–Quercus* (interval 20–130 cm): the spectra are predominated by alder (*Alnus*) (25%) and oak (*Quercus*) (15%) pollen. The content of lime and elm pollen decreases in this zone. Pine, nut-tree and birch pollen account for 20% each;

zone 5 – *Pinus–Picea* (interval 3–20 cm): herbs account for 15% of the total spectral composition. The content of broad-leaved pollen decreases, while the content of pine and spruce (*Picea*) increases. Single cereal pollen were identified in the spectra.

According to diatom species composition and quantitative relations of species, the sediment core PSh-5441 is divided into four local diatom zones (LDZ). The zones are described from the bottom to the top of the section (Fig. 3).

LDZ-1. In the interval of 300–372 cm diatoms were absent, excluding any possibility to reconstruct the conditions of the ancient basin, under which light brown clay was forming.

LDZ-2. Within the interval of 208–300 cm, with the bluish grey clay, single benthic diatoms of brackish water *Paralia sulcata* (Ehrenberg) Cleve, *Campylodiscus echeneis* Ehrenberg and a few freshwater benthic diatoms were found.

LDZ-3. Mud in the interval 80–208 cm contained high numbers

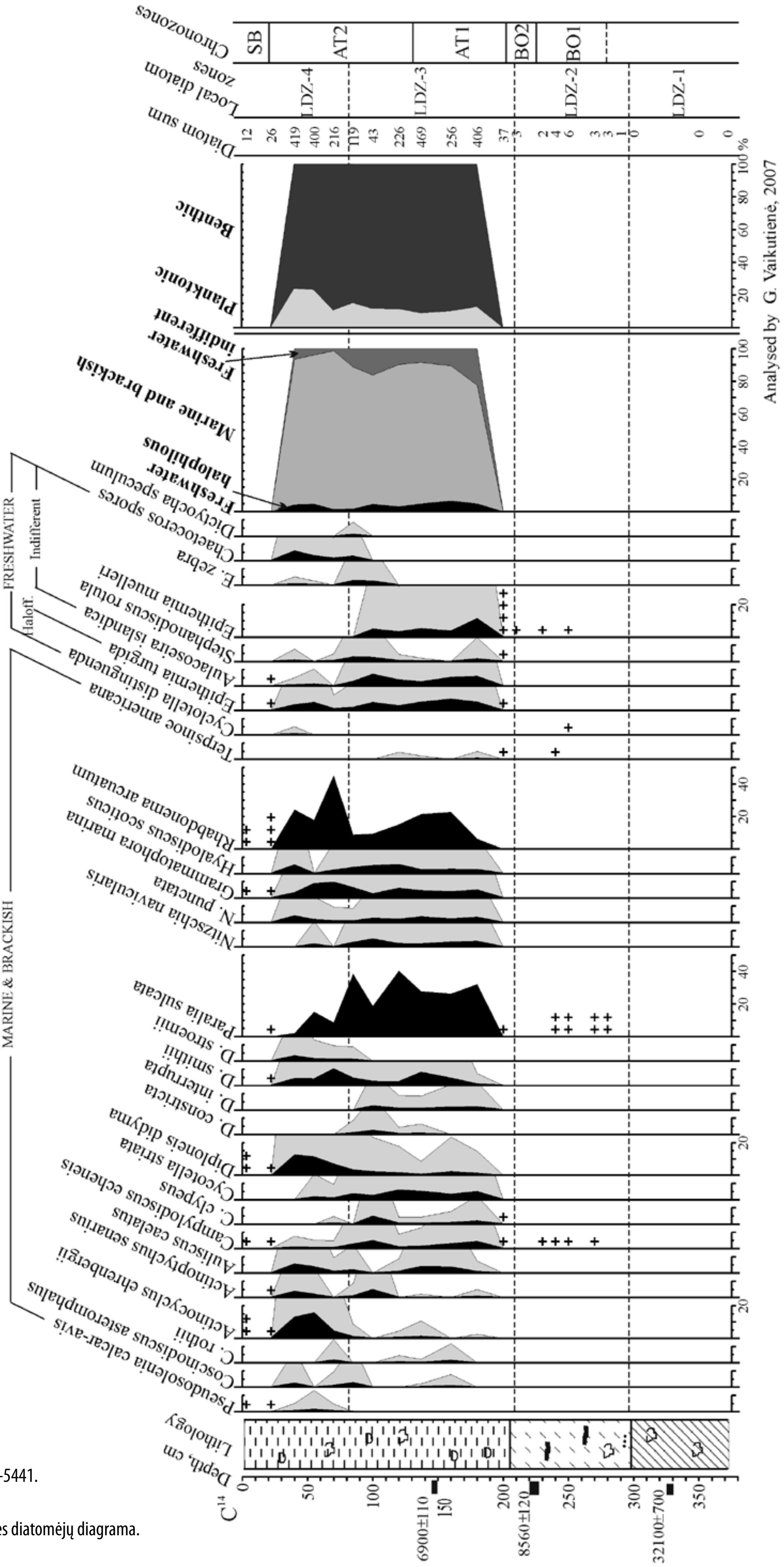

Fig. 3. Abbreviated diatom diagram of core PSh-5441. For the legend, see Figs. 1 and 2

3 pav. Sutrumpinta PSh-5441 nuosėdų kolonėlės diatomėjų diagrama. Sutartinius ženklus žr. 1 ir 2 pav.

of diatoms. Benthic diatoms accounted for 90% with the domination of brackish water *Paralia sulcata* and *Rhabdonema arcuatum* (Lyngbyae) Kützing. Brackish benthic *Paralia sulcata* in this interval make up to 40% at some depths. This diatom species can spread under planktonic and benthic conditions, but mainly in the relatively shallow sublittoral part of the basin. Brackish benthic diatoms *Diploneis smithii* (Brébisson) Cleve, *Grammatophora marina* (Lyngbyae) Kützing, *Hyalodiscus scoticus* (Kützing) Grunow, and *Nitzschia navicularis* (Brébisson) Grunow were also found in small amounts (up to 5%). In this interval, freshwater diatoms make up to 20%, with mainly epiphytic *Epithemia turgida* (Ehrenberg) Kützing, *E. mülleri* Fricke and planktonic *Aulacoseira islandica* (O. Müller) Simonsen found there.

LDZ-4. Mud in the interval 0–80 cm contains a large number of diatoms. Benthic diatoms dominate (up to 75%) with mainly brackish waters *Rhabdonema arcuatum, Paralia sulcata, Diploneis didyma, D. smithii, Grammatophora marina.* Diatom resting spores *Chaetoceros* sp. Ehrenberg were found too. The content of planktonic diatoms increases to 35% at a depth of 25–60 cm due to a higher content of brackish planktonic diatoms *Actinocyclus normanii* (Gregory) Hustedt. Sediments of this zone are predominated by marine and brackish water diatoms. The content of freshwater diatoms reduces to 10%. The content of diatoms in the sediments of the upper part of the section (0–25 cm) is small, although the same species were detected in the sediments of the underlying interval (25–80 cm). Thus, it might be presumed that the ecological conditions of the basin changed very little. However, the conditions determining the preservation of diatoms in sediments might have changed.

DISCUSSION

The lithostratigraphical subdivision of the sediment section PSh-5441 from the Arkona Basin is basically supported by data of absolute age ^{14}C and the spectrum of spores–pollen. The spores–pollen diagram of this core correlates well with diagrams of other sediment cores from different areas of the Baltic Sea (Кабайлене и др., 1978; Клейменова и др., 1978; Гудялис (ред.), 1985; Клейменова, 1988; Емельянов и др., 2001; Yuspina, Savukynienė, 2002; Юспина, 2004 and others).

The oldest sediments of the investigated section in the Arkona Basin are composed of light brown heterogeneous clay with lenses of carbonaceous material. The palaeontological data on the formation conditions of these clays were not obtained. However, as the increased age was already mentioned, the brownish clay in the lower part of the section contains re-deposited material with a higher concentration of carbonates typical of the Baltic periglacial lakes (Блажчишин и др., 1976).

The bluish grey clay (205–295 cm) overlying the light brown clay differs macroscopically in many properties. One of the most significant features is black patces because of iron monosulphides and solid small nodules found in some places. The boundary between different clay layers is distinct and slanting, allowing to consider the interruption of sedimentation, which could result not only from non-deposition of sediments, but also from their washout. These events took place in the southwestern Baltic Sea region, which at the beginning of the Preboreal was the land (Блажчишин, 1984; Emelyanov, 1995) and the area of the section PSh-5441 was near the shoreline of the Baltic Ice Lake (Jensen et al., 1997; Moros et al., 2002).

It should be pointed out that in the 285 cm horizon there is a thin (0.5 cm) dark grey silt (sand?) streak. This may be a fragment of thin sand layers which, according to the new seismoacoustic data, comprise clear reflection horizons in the Arkona Basin. They mark the periods of water level falls and the basin becoming more hydrodynamically active (Moros et al., 2002). Thus, the interval of 285–295 cm might correspond to the peak of regression after the Baltic Ice Lake. However, there is not enough data to determine a more precise time and duration of this regression. The overlying bluish grey clays do not have indications that could be interpreted as traces of a radical change of the sedimentary environment.

The change of clay tint in most of the Baltic Sea deepwater sediments is taken as a stratigraphical boundary between the Baltic Ice Lake and the Yoldia Sea stages. However, new studies (Moros et al., 2002) and detailed investigations revealed that the boundary between grey and brown clays can be related to diagenetic processes (Lepland, 1998) during which Fe is included in the formation of sulphide minerals (solid nodules) and the initial brownish-brown tint turns into grey.

According to the results of palynological analysis (zone I), the bluish grey clays in the sea bottom might have accumulated in the Boreal when pines grew along the shoreline. On the chronostratigraphical scale, the Ancylus Lake stage (LDZ-2) of the Baltic Sea corresponds to the Boreal (Björck, 1995 and others). Sediments of this period contain only single benthic brackish and freshwater diatoms showing that water salinity might be low and the basin shallow. However, the number of diatoms found is too small for reliable conclusions about the palaeoecological conditions of the basin. Moreover, LDZ-2 diatoms are untypical of the Ancylus Lake and evidently appeared in the sediments as a result of re-deposition.

Thus, the thickness of clays from unit II would comprise 90 cm and its sedimentation rate would be about 39 cm/1000 years, considering that this period (after the Baltic Ice Lake stage) lasted from 10.3 to 8.0 thousand years (Björck, 1995). On the other hand, it is possible to consider the end age of the Ancylus stage to be 8.0 thousand years and the age of the interval 205–228 cm 8560 years; then the rate of clay deposition would be 41 cm/1000 years. According to other calculations, as already mentioned, Ancylus clays might have deposit even more rapidly. These numbers confirm a rather intensive accumulation of sediments which, looking at other sediment sections, varied in different parts of the sea (Купцов и др., 1984; Емельянов и др., 1995).

The overlying greenish grey silty-clayey mud (0–205 cm), distinguished as the independent lithostratigraphical unit III, has got typical palaeobotanical features of the Holocene. From the spores–pollen spectrum of this interval, a clear quantitative shift between the ratio of coniferous and deciduous tree pollen is obvious. The land vegetation during the mentioned period was represented by broad-leaved forests with nut-tree underwood and admixes of pines and alders. This corresponds to the Atlantic and the initial Subboreal chronozones (Litorina Sea stage) of the Baltic Sea. The sediments contain great amounts of diatoms.

Their complexes (LDZ-3 and LDZ-4) confirm a high water salinity but a relatively low depth of the Arkona Basin at that time.

On the basis of diatom analysis, it is possible to distinguish two phases of the Litorina Sea sediment formation. One of them would correspond to sediments of the interval 80–208 cm, which accumulated during the lower Atlantic (AT1) and the first half of the upper Atlantic (AT2). At that time the Litorina Sea was not deep, because benthic diatoms typical of shallow areas of the sea prevail. The dominant *Paralia sulcata*, which lives in plankton or under benthic conditions, shows that the environment was sub-littoral rather than littoral. The dominant brackish water diatoms confirm that the Litorina Sea water salinity was not low, typical of this stage.

The sediments of the upper part of the section (0–80 cm) accumulated during the second half of the upper Atlantic (AT2) and at the beginning of the Subboreal (SB), i. e. in the second half of the Litorina Sea stage. The species composition of diatoms slightly changed. The higher amount of brackish epiphytic diatoms *Rhabdonema arcuatum* (at a depth of 60–80 cm) shows that the depth of the sea slightly decreased, and more aquatic plants growing in the shallow water zone could spread. The brackish planktonic diatoms *Actinocyclus ehrenbergii*, *Chaetoceros* sp. diatom resting spores, which appeared at the end of the Atlantic (25–60 cm), may suggest a small short-lasting rise of water level and water salinity. Nevertheless, benthic diatoms dominate, so the sea level rise in the Arkona Basin is weakly reflected in this section.

The top layer (0–25 cm) contains few diatoms. They are typical of the Litorina Sea sediments, as the ones in the underlying interval, i. e. brackish benthic diatoms. It is possible that at the beginning of the Subboreal only small amount of diatoms remained in sediments because of changes in environmental conditions. The average sedimentation rate at the Litorina Sea stage was 21.7 cm/1000 year. However, the sediment composition and their accumulation conditions according to diatom complexes show that deviations from the average value were considerable.

CONCLUSIONS

The sediments of the studied area of the Arkona Basin are represented by the Late Glacial and post-glacial clays and the Litorina Sea mud. The different sediment types of the section PSh-5441 reflect fundamental shifts in the sedimentary environment of the Baltic Sea, which occurred because of deglaciation of the territory and climate changes in the Holocene.

The layers of brown and grey clays are separated by sedimentation hiatus. The lower part of bluish grey clay layer represents a transitional interval between the Late Glacial and the Holocene. Single diatoms found in the clay are not typical of Ancylus Lake and might result from re-deposition processes in the basin. The bulk of grey clays were formed in the Boreal. In general, according to lithological and palaeobotanical evidence, the thin clay complex (units I and II) formed under an especially changeable environment which could exist rather in a very shallow basin.

The sedimentary environment in the Arkona Basin was different during the Litorina Sea stage. Thus, it is possible to distinguish two marine sedimentation phases. During the first phase, sedimentation took place under sub-littoral conditions with not very low water salinity. During the second phase, there was a minor rise of the water level with a slight increase of water salinity. However, these changes are poorly reflected in the diatom species composition. Sedimentation took place under the shallow sea conditions.

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SEDIMENTACIJA VAKARINĖJE BALTIJOS JŪROS DALYJE PAGAL ARKONOS DUBURIO NUOSĖDŲ KOLONĖLĘ

Santrauka

Arkonos duburys, esantis labiausiai į vakarus nutolusioje Baltijos jūros dalyje, turėjo savitą vėlyvojo ledynmečio ir poledynmečio raidą, kurią atspindi dugno nuosėdų sluoksniai. Reprezentaciniame šio duburio pjūvyje PSh-5441 (jūros gylis 46 m) buvo atliktas litostratigrafinis suskirstymas, paremtas sedimentologinės analizės rezultatais ir radiokarboniniu (^{14}C) datavimu. Biostratigrafinei analizei panaudoti sporų-žiedadulkių spektrai, o sedimentacinės aplinkos vertinimui – nuosėdų diatomėjų tyrimai.

Arkonos duburio šiaurinės dalies pjūvį sudaro vėlyvojo ledynmečio bei poledynmečio molis ir dumblas, kurie susiklostė pasitraukus ledynui. Nustatyta, kad rudo ir pilko molio sluoksniai, kuriuos vieną nuo kito skiria sedimentacinė pertrauka, formavosi labai kaičiomis aplinkos sąlygomis, kurios sekliame baseine galėjo susidaryti Baltijos ledyninio ežero stadijos pabaigoje ir vėliau. Šiam raidos etapui būdingi aktyvūs nuosėdų perklostymo procesai jūros dugne. Litorinos jūros stadijoje išskirti du sedimentacijos etapai. Pirmojo etapo metu vandens druskingumas buvo nemažas, sedimentacija vyko sublitoralinės aplinkos sąlygomis. Antrajame etape vandens lygis, matyt, truputį pakilo, šiek tiek padidėjo vandens druskingumas. Nuosėdos kaupėsi negilioje jūroje.

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СЕДИМЕНТАЦИЯ В ЗАПАДНОЙ ЧАСТИ БАЛТИЙСКОГО МОРЯ ПО ДАННЫМ КОЛОНКИ ОСАДКОВ ИЗ АРКОНСКОЙ КОТЛОВИНЫ

Резюме

Арконская котловина, наиболее удаленная к западу часть Балтийского моря, имеет свою отличительную поздне- и послеледниковую историю развития. Эволюция бассейна хорошо отражается в напластовании донных отложений. Представительный разрез донных осадков этой котловины PSh-5441 (глубина моря 46 м) на основе результатов седиментологического анализа и радиоуглеродного (^{14}C) датирования был расчленен на литостратиграфические пачки. Для биостратиграфического анализа были использованы споро-пыльцевые спектры, а условия седиментационных обстановок оценены по материалам изучения диатомей в осадках.

Разрез северной части Арконской котловины представлен поздне- и послеледниковыми глинами и илами, которые отложились после дегляциации территории. Было выявлено, что слои бурых и серых глин, разделенных седиментационным перерывом, сформировались при сильно менявшихся условиях. Такая обстановка могла появиться в мелководном бассейне в конце стадии Балтийского ледникового озера и позже. Для этого этапа характерны активные процессы переотложения осадков на дне моря. На стадии литоринового моря были выделены два этапа осадконакопления. Во время первого этапа соленость воды была значительной, осадки накапливались в сублиторальных условиях. На втором этапе уровень моря несколько повысился, также возросла и соленость воды. Обстановка осадконакопления соответствовала условиям неглубокого морского водоема.