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The Impact of Environmental Factors on the Composition of the Diatoms in the Sediments of the Pavlovka River (Primorsky Krai, Russia)

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Abstract: This paper presents the results of a study of diatoms from the sediments in headwaters of the river Pavlovka (K-EL007). The diatom taxonomic composition, ecological structure and their quantitative content were analyzed. 120 diatom species belonging to 38 genera were ideated. The data allowed to allocate 7 ecozones. The changes revealed in the ecological structure of the spore-pollen spectra and diatoms paleo-community allowed to assume during what time these sediments were formed and under what climatic conditions.

Keywords: Diatom, Climate Change, Primorsky Krai

1. Introduction

The research of environmental change Primorsky Krai is very interesting for paleoclimatology, archeology, ecology and paleoecology. The source of such information are the various paleo-indicators, such as of diatoms. Diatom analyzes one of the most important methods micropaleontological because of diatoms are sensitive to changes in the environment, they have a rapid evolutionary transformation that helps with biostratigraphic scheme of detail. Widespread diatoms in sediments of marine and continental facies and well-preserved valves, in their turn allows you to confidently determine the genesis of sediments [1, 2, 3, 4, 6, 7, 22].

We have studied sectional, late-glacial sediment in the upper stream of the river Pavlovka (K-EL007). This river is in Chuguyivsky region Primorsky Krai and Russia (former appellation - Fudzin) is the right tributary of the Ussuri river. The length of the Pavlovka river - 132 km, the total area of basin - 3360 km² [9]. (Figure 1)

2. Materials and Methods

Preparation of samples to conduct diatom analysis was carried out using standard techniques. To analyze the relationship between the frequency of occurrence separate taxa and environmental groups more than 250-300 diatom valves calculated, providing statistical sample. [8] Identification of the species composition of diatoms, was carried out using light microscopes Axio Lab. A1 Zeiss [4, 8].

Figure 1. *Location of the studied section of the Pavlovka river (K-EL007).*

To identify the species composition of diatom flora were using monographs, reports and identifiers national and foreign authors [8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21].

A study section late-glacial sediments in the upper reaches of the river Pavlovka (K-EL007), diatom flora is represented by 120 species and intraspecific varieties belonging to 37 genera.

Table 1. *The most informative diatom species of the section of K-EL007.*

Most representative taxa of diatoms	Environmental groups of diatoms						
	1	2	3	4	5	6	7
Aulacoseira granulata (Ehr.) Sim.	+						
Aulacoseira italica (Ehr.) Sim.	+						
Caloneis leptosoma (Grun.) Kram.					+		
C. silicula (Ehr.) Cl.				+			
Cymbella aspera (Ehr.) Cl.				+			
C. stuxbergii (Cl.) Cl.						+	
C. tumida (Bréb.) Heurck					+		
Diploneis elliptica (Kütz.) Cl.				+			
Encyonema hebridicum (Greg.) Grun.				+			
Eunotia bidens Ehr.				+			
E. bigibba Kütz.				+			
E. fallax Cl.				+			
E. gracilis Smith				+			
E. incisa Smith ex Greg.				+			
E. minor (Kütz.) Grun.				+			
E. sudetica Müll.				+			
E. tauntoniensis Hust. ex Patr.					+		
E. valida Hust.				+			
Hantzschia amphioxys Grun.				+			
H. elongata (Hantz.) Grun.				+			
H. vivax (Smith) Grun.							+
Navicula amphibola Cl.				+			
N. dicephala Ehr.				+			
Neidium iridis (Ehr.) Cl.				+			
Nitzschia sigma (Kütz.) Sm.							+
Melosira islandica Müll.			+				
M. varians Agardh		+					
Pinnularia borealis Ehr.				+			
P. brevicostata Cl.				+			
P. brebissonii (Kütz.) Raben.				+			
P. cardinalis (Ehr.) Smith				+			
P. dactylus Ehr.				+			
P. divergentissima (Grun.) Cl.				+			
P. episcopalis Cl.					+		
P. gentilis (Donkin) Cl.				+			
P. gibba Ehr.				+			
P. lata (Bréb.) Smit.				+			
P. major (Kütz.) Rab.				+			
P. nobilis (Ehr.) Ehr.				+			
P. streptoraphe Cl.				+			
P. viridis (Nitz.) Ehr.				+			
Rhoicosphenia abbreviata (Agar.) Lange-Bertalot							+
Stauroneis anceps Ehr.				+			
Synedra ulna (Nitz.) Ehr.			+				
Tabellaria fenestrata (Lyng.) Kütz.		+					
T. flocculosa (Roth) Kütz.		+					

Table 1 shows 48 species the most informative section K-EL007.

These species are separated into 7 ecological groups:

1 group - planktonic southern boreal,

2 group - plankton arkto- and north-boreal,

3 group - plankton north-boreal,

4 group -benthic arkto- and north-boreal,

5 group - benthic southern -boreal,

6 group - benthic southern-boreal brackish species,

7 group - the north boreal brackish benthic species [1, 2, 3, 4, 5]

The sediment partizansk horizon constitute the middle part the incision 4 meter terrace and are located at the roof blurred chernoruchinsky horizon, we allocated 5 complexes of diatoms, which reflect paleoecological succession.

3. Results and Discussion

Complex 1 is selected in the range 230-210 cm. It consists of benthic species of diatoms (a group of 4-arcto - and north-boreal types). In the complex *Pinnularia streptoraphe* Cl. (22%), *P. lata* (Breb.) Smith (12%), *P. viridis* (Nitz.) Ehr. (10%), *P. gentilis* (Donkin) Cl. (10%), *R. brevicostata* Cl. (11%), *Hantzschia amphioxys* Grun. (8%) is dominated.

Complex 1 contains small numbers of diatoms 6 group - *Epithemia adnata* var. *porcellus* (Kütz.) Ross. Spore-pollen spectrum corresponds to the complex of diatom 1 characterized with an abundance of pollen of broad-leaved trees on the background of reducing pollen broadleaf species [23].

Complex 2 was selected in the range 210-200 cm enough captures a sharp decrease in the number of benthic arcto - and north-boreal diatom species. Form a moderately warm water brackish species (group 6) *Epithemia adnata* (Kütz.) Breb. (8%) and benthic north boreal brackish (group 7) *Nitzschia sigma* (Kütz.) Smith (5%), *Hantzschia vivax* (Sm.) Grun. (6%), on the background of dominance of diatoms 4 groups *Pinnularia brevicostata* Cl. (14%), *P. streptoraphe* Cl. (12%), *P. viridis* (Nitz.) Ehr. (8%), *P. borealis* Ehr. (6%), *P. lata* (Breb.) Smith (4%).

We allocated from the sediments of the interval spore-pollen spectra, which is dominated by pollen of parvifoliate birch *Betula mandshurica* (Rgl.) Nakai (70%), *B. sp*. (20%), *B. sect.* Nanae (2%). Against the background of a slight presence of pollen broadleaf *Quercus*, *Ulmus* [23].

Complex 3 was selected in the range 200-190 cm. In this complex, again observed growth in the number of benthic species in northern latitudes (group 4): *Pinnularia brevicostata* Cl. (23%), *P. streptoraphe* Cl. (17%), *P. viridis* (Nitz.) Ehr. (12%), *Eunotia bidens* Ehr. (9%), *E. valida* Hust. (6%), *Navicula amphib*ola Cl. (6%). Data spore-pollen analysis according an increase in the number of pollen dark coniferous species with decreasing representatives of broadleaf species in complexes 1 and 3 [23].

Complex 4 was selected in the range 190-170 cm. It is characterized by the disappearance of the majority of species Eunotia and noticeable reduction in the number of species Pinnularia (up 6%), with the appearance of 3 and 5 representatives of environmental groups diatoms. There are planktonic (up 7%) *Aulacoseira italica* (Ehr.) Sim., *A. islandica* (Müll.) Sim. and of benthal-littoral species of the temperate latitudes: *Pinnularia episcopalis* Cl. (15%),

Caloneis leptosoma (Grun.) Kram. (10%), *Eunotia tauntoniensis* Hust. ex Patrick (3%), *Cymbella tumida* (Bréb.) Heurck (3%), *C. stuxbergii* (Cl.) Cl. (4%). The spore-pollen analysis revealed the dominance of parvifoliate pollen, as well as in complex 2 [23].

Complex 5 was selected in the range 170-105 cm. The dominants are representatives of four groups of diatoms, benthic and arkto- north-boreal species: *Eunotia bidens* Ehr. (16%), *Pinnularia streptoraphe* Cl. (12%), *P. brevicostata* Cl. (5%). Appears representative of the 3 groups of diatoms *Synedra ulna* (Nitz.) Ehr. (8%). Against the background of a slight presence of types 5 and 7 groups of diatoms. These spore-pollen spectra from sediments of the interval reflects a decrease pollen broadleaf species with an increase in the total number of pollen dark coniferous species [23].

Complex 6 was selected in the range 105-35 cm. Sediments of the layer presented loam and peaty aleurite. Dominating the complex are representatives of 4 groups of diatoms (benthic species arkto- and north boreal): *Pinnularia streptoraphe* Cl. (9%), *Navicula dicephala* Ehr. (7%), Hantzschia amphioxys Grun. (6,5%), *Eunotia minor* (Kütz.) Grun. (6%), *E. bidens* Ehr. (6%). *Pinnularia streptoraphe* Cl. (9%), *Navicula dicephala* Ehr. (7%), *Hantzschia amphioxys* Grun. (6,5%), *Eunotia minor* (Kütz.) Grun. (6%), *E. bidens* Ehr. (6%). Because diatom 1 group (9%) marked *Aulacoseira granulata* (Ehr.) Sim., *A. italica* (Ehr.) Sim. This complex reflects the appearance of diatom species 2 group (7%) *Melosira varians* Agardh, *Tabellaria fenestrata* (Lyngbye) Kütz., *Tabellaria flocculosa* (Roth) Kütz. Also in the complex are representatives 5 (*Pinnularia episcopalis* Cl to 6%.) and 7 environmental groups of diatoms: *Rhoicosphenia abbreviata* (Agardh) Lange-Bertalot, *Nitzschia sigma* (Kütz.) Smith, *Hantzschia vivax* (Smith) Grun.

It is worth noting that the complex the species composition is similar to the complexes 2 and 4, but the species composition of its undoubtedly wider. This type of complex is similar to modern sediments swamp floodplain lakes with low pH (5-6) [4].

Complex 7 was selected in the range 35-20 cm The main role in the structure of this complex play diatoms 4 groups: *Pinnularia cardinalis* (Ehr.) Smith (10%), *Hantzschia amphioxys* Grun. (10%), *H. elongata* (Hantz.) Grun. (12%). It is impossible not to note the growth of the number of species of diatoms, group 5: *Pinnularia episcopalis* Cl. (8%).

4. Conclusion

Identified changes in the ecological structure of the diatom paleo-communities and spore-pollen spectra suggest that the formation of complexes sediments 1, 3 and 5 can be roughly classified according to the Early, Middle and Younger Dryas, and the complexes 2 and 4 - to Boelling and Alleroed. The spore-pollen analysis adds confidence in this conclusion. Complexes 6 and 7 correspond to Preboreal and Subatlantik respectively [4, 23].

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