Distribution of Holocene sediment thickness on the northwestern Black Sea shelf

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Introduction

Reconstruction of the geological history and neotectonic activity of the northwestern Black Sea shelf requires an analysis of the thickness of the Holocene deposits. The study region includes the inner shelf from the Sarat rise to the central part of the Tendra rise, and it encompasses the middle shelf and substantial areas of the outer shelf to the south. Using vibracore data from "Prichernomorgeologia," we obtained more than 400 measurements of deposit thickness, as well as 28,100 interpolated values. The main goal of the research is assessment of the spatial distribution of deposit thickness on the northwestern Black Sea shelf through standard statistical analyses and GIS-aided mapping. The objectives are: evaluation of statistical parameters of sediment thickness distribution, and mapping of areas with anomalous Holocene deposit thicknesses.

Results

Based on the law of distribution, sediment thickness has a logarithmic character. The bimodal nature of the histogram points to a non-uniform selection. The main factors responsible for the distribution of deposit thickness on the northwestern Black Sea shelf include topography, sedimentary setting, and tectonic movements, with antecedent topography being undoubtedly the key factor. We distinguish several seafloor regions, including bathymetric rises, depressions within the inner shelf, and the level surface of the middle and outer shelf (Larchenkov, Kadurin, 2007). The thickness values were determined for the Sarat, Dniester, and Tendra rises, Odessa bank, depressions of the Sarat, Dniester, and Dnieper river paleo-valleys, and the mid- to outer shelf region. For each seafloor region, the following statistical parameters have been determined: mean thickness, standard deviation, variation coefficients asymmetry, excess, mode, and scattering.

Comparisons based on the Fisher criterion (uniformity of scattering) show that sediment thickness values correspond to three general categories: 1) rises; 2) paleo-valleys, and 3) mid- to outer shelf (Figs. 1-3). The normal thickness for each region corresponds to a mean value with a standard deviation, with deviations in thickness considered as positive or negative anomalies (Table 1):

Table 1. Average and anomal thickness of the Upper Pleistocene-Holocene sediments in different geomorphological areas of the shelf.

Region	Sediment thickness (m)		
	Mean	Negative anomaly	Positive anomaly
Bathymetric rise	0.4 – 3.1	< 0.4	> 3.1
Depression	3.2 – 7.9	< 3.2	> 7.9
Middle to outer shelf	0.3 – 1.8	< 0.3	> 1.8

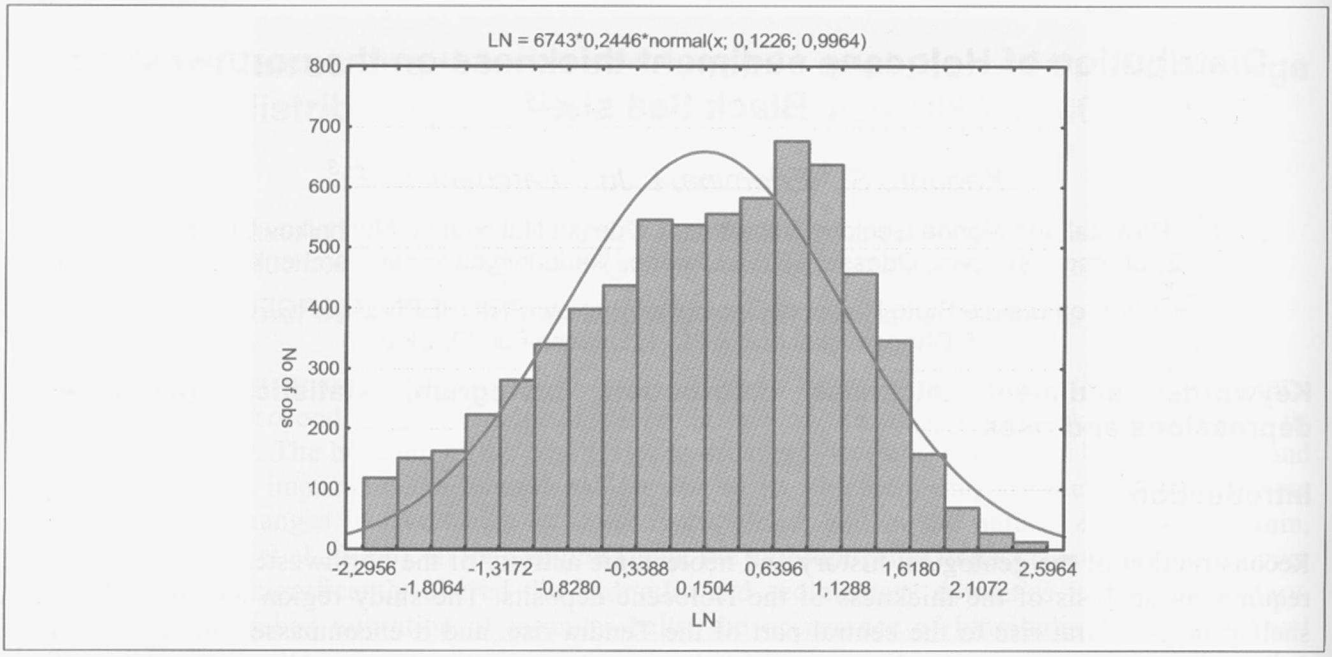

Figure 1. Logarithmic histogram of sediment thickness of bathymetric highs.

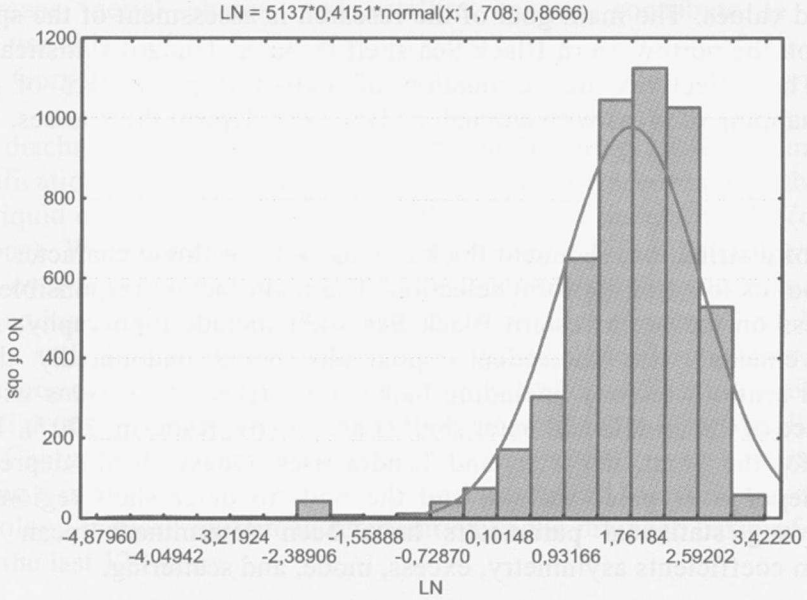

Figure 2. Logarithmic histogram of sediment thickness in depressions.

Summary

1) The spatial distribution of Holocene deposit thickness is non-uniform, with asymmetric distribution skewed toward smaller values. The main distribution histogram clearly demonstrates the non-uniformity of selection manifested by two modes on the graph.

2) Based on the Fisher criterion, the distribution of sediment thickness belongs to the three general groupings of bathymetric rises, depressions, and mid- to outer shelf.

3) The spatial distribution of positive and negative thickness anomalies has been established.

4) Based on statistical results of Holocene sediment thickness, the boundaries of major seafloor regions have been refined.

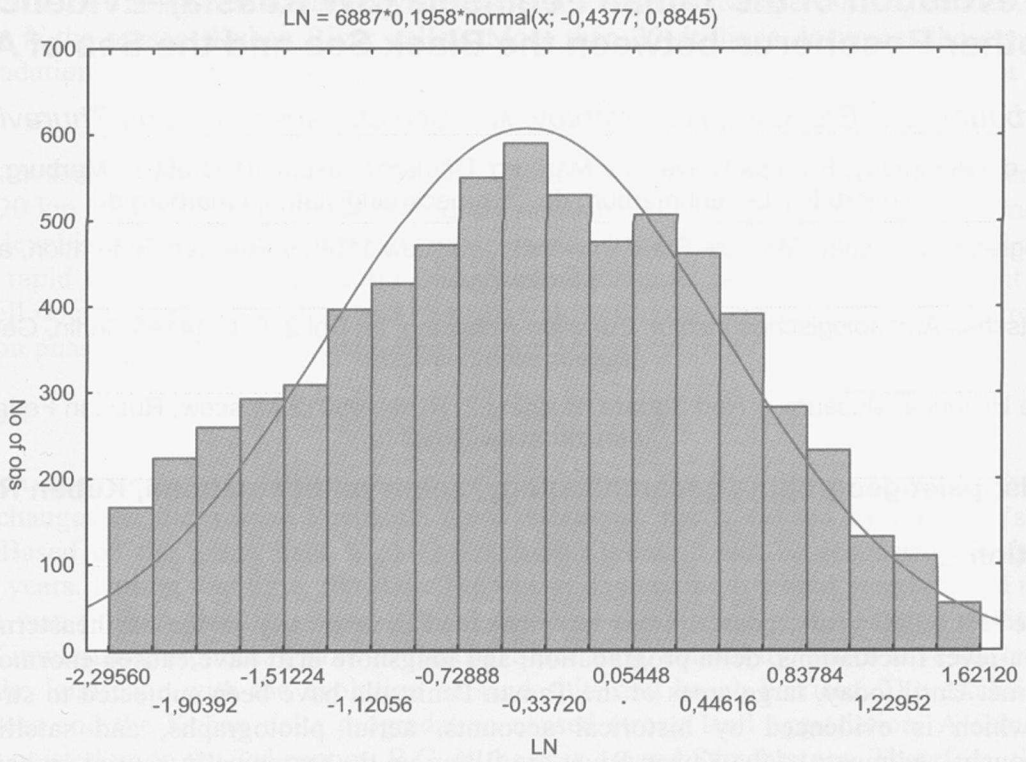

Figure 3. Logarithmic histogram of sediment thickness distribution on mid- to outer shelf.

Reference

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