Holocene coastlines position reconstruction within the northwestern Black Sea Shelf

Tyuleneva, N.V., [1] and Suchkov, I.A. [2]

[1,2] Odessa I.I. Mechnikov National University, Geological-Geographical Faculty, Department of Physical and Marine Geology, 2, Shampansky Per., Odessa 65058, Ukraine

[1] tyuleneva@yandex.ru, [2] marine@paco.net

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Introduction

Reconstruction of coastline positions during the Holocene (i.e., Bugazian, Vityazevian, Kalamitian) within the northwestern Black Sea shelf is an integral part of the growing knowledge of geological history. During the last few decades, new notions have emerged about Late Pleistocene-Holocene paleogeography, and new data about Black Sea level fluctuations have appeared (Emelianov et al., 2004; Granova, 2001; Konikov, 2007; Molodykh et al., 1984; Shnyukov, ed., 1985; Ryan, 2003; Yanko-Hombach, 2007).

Methodology

The study area is situated within the northwestern Black Sea shelf. The northern boundary of the area is the modern coastline; the southern boundary is the modern isobaths at 50–55 m.

Results of the investigation are based on vast factual material. Composition characteristics of Bugazian, Vityazevian, Kalamitian, and Dzhemetinian bottom sediments were based on data from over 1,400 boreholes.

In the work, the literature and archival data of the Laboratory of Geology and Geochemistry of Odessa I.I. Mechnikov National Univesrity and the Black Sea State Regional Geological Enterprise "Prichernomor GRGP," Odessa, were utilized, as were the results of investigations conducted by the authors.

Processing of geological data included using statistical methods, determining sorting coefficients, and calculating median diameters. GIS-programs (MapInfo) were used for graphical representation of information about coastline position during different ages, and the distribution of Holocene bottom sediment facies.

Results

The reconstruction of coastline positions was based on the following indications: presence or absence of bottom sediments, bottom sediment lithology, changes in facies, and pre-Holocene and recent relief features.

Facies and subfacies of bottom sediments for the studied time intervals were also mapped out. Figures 1–3 show the changing coastline positions combined with the position of the modern coastline, which corresponds to that of Dzhemetinian time.

The first, Bugazian leap of the transgression took place within the range of 10.5 to 8.5 ka (Fig. 1). The Bugazian coastline was very winding with broad bays and limans. The position of the marine bottom sediments is marked by the level of the modern isobaths from –25 to –35 m. The coastline position at that level was confirmed by the results of granulometric composition analysis, and also by the presence of liman, liman-marine, and lacustrine-marshy facies. Bottom sediments of coastal subfacies have good sorting coefficients (S_0 = 1.28). As one samples farther from the coastline, the sorting coefficients become higher. Sediments from the subfacies of the outer shelf are characterized by the following sorting coefficients (S_0 = 1.76–3.23) (Tyuleneva, 2010). At the end of Bugazian time, no significant regression occurred; the markers are observable in the structure of the bottom sediments.

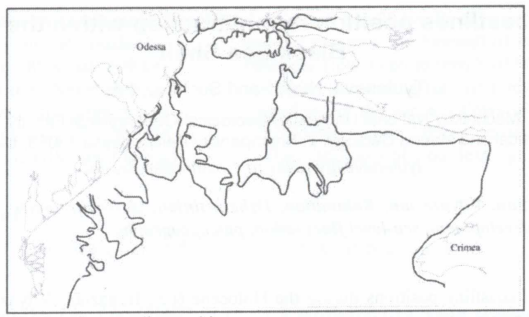

Figure 1. Scheme of the Bugasian coastline position

In the range between 8.5 and 6.5 ka, the second, Vityazevian, leap of the transgression took place. The Vityazevian coastline (Fig. 2) was situated at the level of the modern depth contours at –20 to –25 m, and its outlines were characterized by the presence of bays and limans.

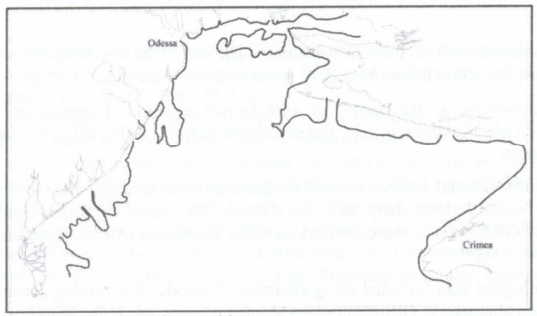

Figure 2. Scheme of the Vitiazevian coastline position

Between 6.5 and 4 ka, the third, Kalamitian, leap of the transgression occurred. Analysis of the data allowed us to plot the position of the Kalamitian coastline at the level of modern isobaths –10 to –15 m (Fig. 3). Outlines of the Kalamitian coastline are smoother by comparison to previous coastlines, but small bays along the shore still existed. In the area of Dniestrovsky liman and Tendra spit, there were places that experienced erosion and where Drevnechernomorian sediments outcrop. Such places are connected with the washing out of Kalamitian sediments.

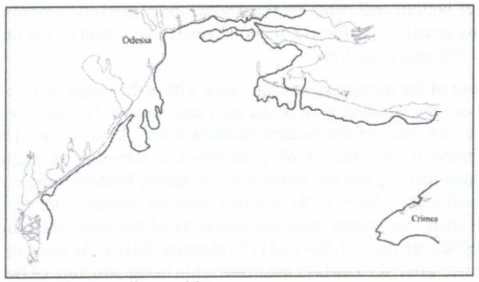

Figure 3. Scheme of the Kalamitian coastline position

The Dzhemetinian leap of the transgression took place at about 4 ka. The recent coastline formed at this time. Limans were separated from the sea by spits and transformed into closed lakes. Odessa's sandbank and the bench became flooded by the sea, and as a result, abrasion processes became more active.

Conclusions

1. Coastlines at every stage of Black Sea basin development were winding, with numerous capes and bays. Lagoons and limans were also widely distributed along the coasts, many of them separated from the sea by spits.

2. Morphological development of Holocene coastlines has a tendency toward contour smoothing from Bugazian to Dzhemetinian time.

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