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**SEA LEVEL RISE AND HUMAN ADAPTATION
TO ENVIRONMENTAL CHANGES DURING THE LATE
PREHISTORY ALONG THE WESTERN BLACK SEA COAST**

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Abstract

The climatic changes, the sea level changes and the palaeoecological conditions of the Black Sea coastal area during the Holocene have been reconstructed and discussed from the point of view of the submerged prehistoric settlements, dating from the Eneolithic period and the Early Bronze Age. The established settlements have been analysed from their geomorphological position with the methodology of underwater archaeology. A number of submerged prehistoric settlements are known along the western coast of the Black sea. Geomorphological analysis and methodology of underwater archaeology indicates their existence from the Eneolithic period and Early Bronze Age (between 6500-4000 BP). This has also been proven by the curve of the changes of the sea level during the Holocene in the western part of the Black Sea. In the peculiar context along the western Black Sea coast numerous recent works have shown that at the beginning of the Holocene, the Black Sea was a water expanse disconnected from the Mediterranean. This connexion occurred sometime around 6700–6500 BC. This phenomenon resulted in a rapid rise of the sea level and consequently in “dramatic” changes in the coastline geometry and fluvial dynamics. These modifications probably affected the capacities of these coastlines and deltaic areas to produce and maintain biodiversity. The general worldwide sea-level rise was and still is a major source of social, geographical and environmental transformations.

Key words: palaeogeography, geoarchaeology, prehistory, submerged settlements, Holocene sediments, biostratigraphy

Introduction. Humid zones of the Earth are of an outstanding importance as natural habitats that provide shelter to a great variety of species. In the west-

ern Black sea coast, littoral areas (lakes, lagoons and deltas) were formed during the Post glacial transgression. As a result of the Holocene Post glacial transgression, the Black Sea transforms from fresh water lakes into marine basin with palaeoecological features, close to the contemporary characteristics: increase of salinity of about 19‰, increase of temperature and humidity [1]. The characteristics of this climatic optimum are conserved in the marine Holocene sediments. The marine Holocene sediments on the Black sea coast are of high interest to the scientific community. On the one hand, their description is a key to the ancient coastline. On the other hand, from geomorphological point of view, occurrences of the Holocene sediments marking the marine phases in the oscillation sea – firth link would be preserved in the coastal firths. Nowadays, these areas constitute submerged prehistoric settlements, set up along the shoreline. Moreover, these areas preserve a mosaic of biotopes and harbour an important biodiversity. For these reasons they are, and also were in the past, attractive to the human population which exploited them since the Neolithic Period.

Materials and methods. The characteristic feature of this paper is that the data of numerous terrain and marine explorations have been summarised with an aim to reconstruct the development of the Bulgarian Black Sea coast. The palaeogeographical reconstruction has been traced out on the basis of the analysis of the transgressive – regressive cycles, terrace complex along the coastline and lithological and biostratigraphical research on molluscan fauna and palynological data, radiocarbon data, etc. The manuscript discusses the link between the palaeoecological conditions in the beginning of the Holocene and establishment of these settlements, their cultural context and chronological synchrony.

Results and discussion. A number of submerged prehistoric settlements are known along the western coast of the Black sea as eighteen of them are known with certainty. Thirteen settlements have been found in Lake Varna-Beloslav [2]. The remaining five submerged settlements are located along the southern Bulgarian coast. Specifically, these five sites are located west of Cape Atiya [3], Sozopol [4,5], at the mouth of Ropotamo river [6], Stomoplo [7] and to the south of Cape Urdoviza [5]. All eighteen settlements found to date are situated 6 to 9 m below present Black sea level (Fig. 1).

Geomorphological analysis and methodology of underwater archaeology date their existence to the second phase of Eneolithic Period and Early Bronze Age (between 6500–4000 B.P.). This has also been proven by the curve of the changes of the sea level during the Holocene in the western part of the Black Sea.

At the end of the Pleistocene and the beginning of the Holocene the sea level continued rising going in the floated river lowlands. The data of the molluscan fauna and the pollen analysis show that the formation of the coastal lakes is connected with the Holocene transgression and is dated for the lake of Durankulak at about 6170 ± 15 and Shabla-Ezeretz at 6800 ± 100 B.P. [8]. The presence of peat layers and changes in the composition of gastropod fauna in the lake deposits

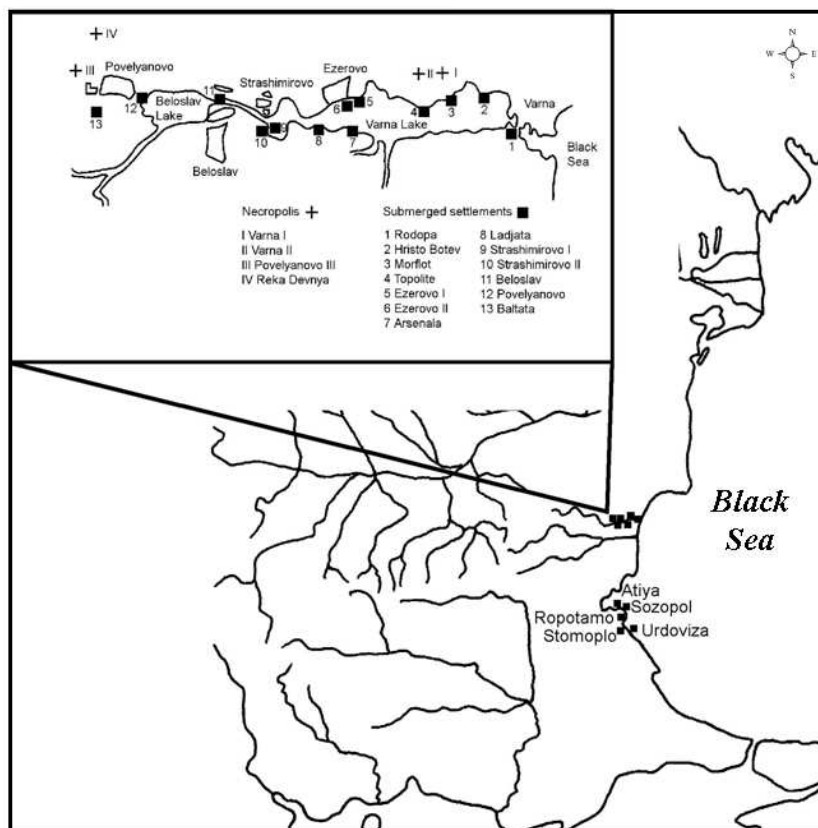


Fig. 1. Map of the submerged prehistoric settlements along the Bulgarian Black Sea coast

give evidence for the periodic disconnection and restored connection of the lakes with the sea [9].

The present firth of Varna-Beloslav was comprised in a large sea bay reaching the mouth of the rivers Provadiyska and Devnya before 5650 B.P. A sea terrace has been left from this period at an elevation of 4 m fragmentary developed on the slopes of the firth. Some fossil fauna has been laid open from the geological cross-section of the terrace in the area of the town of Beloslav. The biostratigraphical analysis shows that at the beginning and the end of that event and the material of the natural reservoir was considerably freshened with abundance of *Theodoxus pallasi* (Lindh.) and *Dreissena polymorpha* (Andrus.), and during the maximum of the transgression its salinity was close to that of the sea which was shown by the presence of halophilous and thermophilous Mediterranean species such as *Ostrea edulis* (L.), *Mytilaster lineatus* (Gm. in L.) [10].

The settlements at the sea side of the Eneolithic age were flooded during that transgression. Some relicts were laid open during underwater archaeological

research in the area of the firth of Varna-Beloslav – thirteen of them altogether, at a depth of 6–9 m to the north of Cape of Atia, in the harbour of Sozopol and Urdoviza near Kiten [6,11]. Human activities at these sites were resumed during the Early Bronze Age. The location of the Early Bronze Age settlements up to the Eneolithic ones was established after a hiatus. Its durations can be measured in quantities of the cores 800–100 years [6].

At the interval between 5140 and 4960 years B.P. another rising of the sea level of short duration was established marked by the coastal terraces between the town of Kavarna via Tuzlata and the mid-section of the sand-pit to the south of Nessebar with lots of shells of Mediterranean mollusks [12].

At the background of the general rising of the sea level through the Atlantic there can also be noticed certain relative falls-before 5990 ± 100 B.P. in the Lake of Shabla-Ezeretz where a considerable increase in the percentage participation of the typically marshy cenosis of pollen can be observed. The cultural layer at depth between 5 m and 4.3 m, discovered during probing in “Arsenal” area (Lake of Varna), dated to 5390 ± 100 B.P., also confirms lowering of sea level at that time [8].

Typical marine deposits of the beach type can be observed at the mouth of the Dyavolska river near the town of Primorsko at an elevation of 2.5 m. Radiocarbon dates have been taken from the molluscan fossil fauna *Ostrea edulis* (L.), *Chione gallina* (L.), *Mytilaster lineatus* (Gm. in L.), *Mytilus galloprovincialis* (Lam.) showing an absolute age of 4590 ± 70 years B.P. and 4325 ± 160 years B.P.

Marine Holocene sediments of the coastline are observed in the section of the sand-pit situated 5 km to the north of the town of Nessebar. The presented section reconstructs the oscillation of the Oldtschernomorian basin to a lagoon, to a shallow sea and again to a coastal basin. Radiocarbon data are obtained from molluscan fauna of *Cardium edule* (L.), *Chione gallina* (L.), 4315 ± 130 years B.P. and of 4960 ± 100 years B.P. [12].

A temporary lowering of the sea level was established at the interval before the year 4170 B.P. and the year 3760 B.P. Some coastal lakes and the sea were disconnected. A complete drainage of the Lake of Durankulak was proved through the presence of a peat layer and the absence of diatoms. It is dated by radiocarbon to have happened at 4080 ± 50 B.P. and 4020 ± 50 B.P. The archaeological materials laid open in the west coastal area can also prove the lowering of the sea level during that period. At a distance of 800–900 m from the present coastal line in the ancient valley of the Karaagatch river in a depth of 2.5 m there have been stated archaeological finds dated according to radiocarbon at 4160–4000 B.P., related to the second phase of the Early Bronze Age [5].

The next rise of the sea level can be proved by the suspension of life in the pre-historic settlements and also by the considerable spreading of the typical marine eurihaline dinoflagellate cysts *Lingulodinium machaerophorum* and akritarchs

Cymathiosphaera globulosa in marine sediments after 3700 ± 105 B.P. The rising of the sea level during that period is marked by terraces at an elevation of 5 m at the Lake of Tuzlata to the east of the town of Balchik, where shells of marine mollusks *Ostrea edulis* (L.) were dated to 3120 ± 50 B.P. [12].

Similar marine deposits can be observed to the south of the cape of Shabla on an abrasion terrace 5–7 m high, as well as in the cross-sections of the course from the firth of the rivers Kamchia, Fandaclijska and Veleka where the absolute age determined is from 3600–3200 B.P.

Conclusions. Throughout the Ice Ages sea levels were mostly lower than now by as much as 150m, creating extensive coastal landscapes attractive to human settlement. Between 16 000 and 6000 years ago, most of this territory was drowned by sea level rise following the last Ice Age, transforming the geographical and environmental context of human development. This drowned landscape preserves valuable sedimentary archives of long-term environmental and climatic changes, and an increasing number of submerged archaeological remains that document human response to this rapidly changing environment.

In the peculiar context along the western Black Sea coast numerous recent studies have shown that in the beginning of the Holocene, the Black Sea was a water expanse disconnected from the Mediterranean. **This connection occurred sometime around 6700–6500 BC.** This phenomenon resulted in a rapid rise of the sea level and consequently in “dramatic” changes in the coastline geometry and fluvial dynamics. These modifications probably affected the capacities of these coastlines and deltaic areas to produce and maintain biodiversity. The general worldwide sea-level rise was and still is a major source of social, geographical and environmental transformations.

Multidisciplinary studies are focussed on the evolution of humid zones since the last glaciation, in order to understand how intensely the climate changes forced biosphere composition and interacted with human evolution.

The main purpose of our project is to conduct a reflection about interactions between societies and environment, during intervals characterised by rapid changes, most specifically climatic ones. It appears to specify the temporalities of these changes, and to acquire a local pattern in high-resolution, from Neolithic (6000 B.C.) to the beginning of Antiquity (200 B.C.).

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