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MORPHODYNAMICS OF THE COASTAL ZONE OF THE NESSEBAR PENINSULA (BULGARIA): ARCHAEOLOGICAL AND GEOLOGICAL BENCHMARKS

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ABSTRACT. The comparison of the values and the relative chronology of the eustatic benchmarks with archeological and historical data shows that essential changes in the morphology of the coastal zone of the Nessebar Peninsula occurred in the Late Holocene as a result of the activation and mutual running of several geodynamic processes, among which the most influential factors were the rise of the sea level, the distractive activity of the sea surf and earthquakes. The extreme periods of the postglacial stadium (during the New Black Sea transgressive period till the middle of the II mill. BC) are: the Phanagorian regressive period in the middle of the I mill. BC; the Nymphaean transgressive period about the third quarter of the I mill. AD; the Korsun regressive period about the middle of the II mill. AD and the Lasic transgressive period during the second half of the II mill. AD. They marked the intervals between two states of the sea level, among which the chronological and topographical archeological correlates of the Nessebar Peninsula are: 1 – the destructions of the classical fortifications (third quarter of the V c. BC), which marked the coast during the Phanagorian regression; 2 – the Late Antique curtain layout (second quarter of the V c. AD), reporting the Nymphaean rise of the sea level; 3 – the collapse of the North wing of the monastery basilica of The Mother of God Eleousa, followed by the renovation of the basilica in 1341/42 during the Korsun recession of the sea; 4 – the collapse of St. Protomartyr Stephen's church in 1855, before the slowing down of the Lasic transgressive period.

The formation of the young Karangatian ledge where most of the urban structures of the Antique, Mediaeval and modern Nessebar were built, was connected to the transgressive period of the development of the Black Sea basin during the Upper Pleistocene (Krustev et al., 1990, 345). During the Post-Karangatian regression which lowered the sea level to -90 meters, the receding waters remade the underwater slope along the Karangatian land. The Nessebar Palaeopeninsula was subjected to the distractive impact of the sea again in the late Holocene during the Old and New Black Sea transgressive period. To the West of Slunchev Bryag, the New Black Sea ledge was mostly accumulative and abradant-accumulative (Fedorov, 1963, 9; Popov, Mishev, 1974, 77, 226, 227). The New Black Sea surf remade the inherited steep slope of Nessebar Palaeopeninsula. During archeological research on the North slope of the peninsula an abradant swath with niches curved in the ground rocks was found (Bozhkova et al., 2007).

Around the middle of the II mill. BC and most of the I mill. AD there was a regressive stage at which height probably the formation of 4-5 m Black Sea continental shelf ledge was finally formed (Orachev, 1990, 44). Its amplitude maximums along the coast are well-found at -2, -3-4, -5-7 and -7-9 meters, to which other coast lines would correspond (Shilik, 1975, 70-73; Shteglov 1978, 15-17, fig. 3; Krustev et al., 1990, table 1). The Holocene transgression affected the rhythm of the liman sediments. In the sand layer of the Handzhiyska River peat streaks were found at 4-5, 10-12, 5 и 20-22 meters (Popov, Mishev, 1974, 152, 158, 162, 225, fig. 63). The first of them, corresponding to the underwater ledge at -4-5 m depth, determined biostratigraphically along the Black Sea coast, directs our attention to the corresponding isobaths around Nessebar Peninsula. More tangible lowering of the underwater lay, probably connected with the Phanagorian coast, can be seen in the aquatory to the East of fourth and fifth izobath (*NEC UNESCO*, 1977; *NEC UNESCO*, 1984, app. 1) and to the South of third and fifth izobath on the peninsula (*NEC UNESCO*, 1978, fig. 6).

Ruins of the antique fortifications are located between the sixth isohipse along the Southwest slope of the peninsula and the sea bottom to the fourth isobath along its Southeast coast. The antique coastal zone is farthest from the modern East slope of the peninsula. The G-shaped curtain of the Dorian fortification, found at 2 m depth, is at a distance of about 170 m to the Southeast, and its conjectural layout should have passed to the East of the peninsula at a distance of at least 250 m (Preshlenov, in press). The localization of the Early Thracian and classical Dorian fortification in the zone of the fifth to fourth isobath in the Southeast and possibly in the Northeast sector of the peninsula suggests that the lower limit of the fluctuations of the water level at the end of the II to the first half of the I mill. BC were down to -5-7 m, which situates the coastal zone during the establishment of the Messambrian polis along and in front of the 4-5 m continental shelf ledge.

The changing paleoecological situation as a result of the rise of the sea level during the Post-Phanagorian transgressive period (second half/the end of the II mill. BC – first half/third quarter of the I mill. AD) seems to have limited the possibilities of expanding the fortified urban area. The new layout of the fortification chosen by the Early Byzantine constructors

confirms the rise of the Black Sea level. Parts of a curtain built in *opus mixtum* in the V c. AD were found in the Southeast bay of the peninsula, 73 to 75 m away from the coast between the second and the third isobaths (Preshlenov, in press). In its *substruction* pilots and wooden grates were found – reinforcement typical for the foundations of the Early Byzantine fortifications (Ovcharov, 1982, 76).

The Nymphaean transgression, which determined the sea level before the end of the I mill. AD along the North Black Sea coast (Nymphaeum, Olbia, Chersonesus) near their modern values, the Korsun regression at the end of the I mill. – first half of the II mill. AD, followed by the Post-Korsun rise of the sea level during XIII to XV c. (Shilik, 1975a, 7, 13, fig. 15) which slowed down not earlier than the middle of the XIX c. (Mikhova, 1998, 67, 68), as well as the seismic activity reported by the Byzantine writers in the XI to XV c. (Orachev, 2002, 249-250) seem to have affected to a certain extent the area of Nessebar Peninsula, as well. The destabilization of the cliff slope and the head of the peninsula ledge imposed the necessity to leave the North wing and the nave of the monastery basilica of The Mother of God Eleousa which probably caused its second renovation, reported in a donation inscription on a silver repoussé cover of the icon of the Mother of God Eleousa from *NEC UNESCO* 1341-1342 (Chimbuleva, Gyuzelev, 2003, 28). The rise of the sea level gradually compromised both the wind protective and the wave protective functions of the tongue-like sector of the sea bottom in front of the basilica, lowering down to 165 m to the North, covered with crashed and worked boulders (*NEC UNESCO,* 1981, app. 3). It probably continued to have wave protective functions for a while even after it submerged under the water some time after the XV c., till it was able to break the base of the waves passing above it.

By the beginning of the XVIII c., under the impact of negative geomorphological processes the Southeast slope of the peninsula retreated to the land too, reaching the Dorian temenos of Zeus and Hera, the Antique Theatre, the Early Christian basilica, inherited topographically in 1704 by the St. Georgi Stari's church and Christ Acropolit's monastery. Ruins of these monuments – parts of bodies of square pillars, smooth and fluted columns, stairlike blocks, rectangular polished slabs and blocks with rabbet for horizontal fitting – were found in the Southeast bay of Nessebar within a range of 250 meters (Preshlenov, in press). The earthquakes registered in 1688 1778 and 1855, sometimes accompanied by slums and huge landslides into the sea also affected the formation of the present layout of the coastal line (Ognenova-Marinova, 1992, 244-245). As a result of the 1855 earthquake St. Protomartyr Stephen's church slid into the sea. Its location judging by the local toponymy was on the East coast near the cliff blockage known by the name of "Saint Stephen" (Kōnstantinidēs, 1945, 149).

The Nessebar Peninsula was completely outlined during the new rise of the sea level, which started in 1923-1925 (Mikhova, 1998, 67, 68) (Fig. 1).

Fig. 1. General view of the Nessebar peninsula (photo from the 50s)

The average annual gradient of sea level rise, measured in Varna, Nessebar and Burgas from 1924 to 1991 amounted to 2.786 mm per year (Veselinov, Mungov, 1998, 70, 71, 76), the average speed of the coastal erosion between Cape Emine and Nessebar was in the range of 0.08 m per year, and the lost area amounted to about 1000 m^2 per year (Peychev, 1998, 141, table 1 и 2). As a result of the impact of the destructive geodynamic processes the coastal slope of the peninsula has changed – narrow and elongated bays and protruding capes have been formed and the older ledges have been blurred and have lost their previous features. In the late XX c. the peninsula was 850 m long, 300 m wide and its surface was about 24 hectares. In comparison with the situation in the middle of the I mill. BC, when the Dorian polis of Mesambria was established on its territory, the peninsula lost not less than two fifths of its surface.

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