Human occupation in the area of Varna Lake, Bulgaria[1]

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Abstract: *During the analyses of the settlement system in the area of Varna Lake are known three periods of large-scale human occupation from the Late Paleolithic until the Late Antiquity. These are the Late Eneolithic, Early Bronze Age, and Antiquity after the Great Hellenic colonization.*

The Western Black Sea coast and especially Varna Lake has attracted man from the ancient times. Until now the most ancient traces of his stay in this region are dated from the Late Palaeolithic (14000-12000 BC). In the Little Cave near the town of Beloslav, Varna district have been found Late Paleolithic flint tools and animal bones. Late Paleolithic artifacts have been found during the excavation in the area of Pobitite Kamuni, too. At the beginning of the Holocene, the Eastern Balkan Peninsula was almost completely uninhabited; the only one Mesolithic site is known from the West Pontic shore. This is the site of Pobiti Kamuni, Varna district. This site revealed numerous microliths, unfortunately unstratified, which belong to the period between 9th and 8th millennia BC.

The more dynamic period of human development in Southeastern Europe is the boundary between the Neolithic and Eneolithic (the very end of the 6th millennium BC – the beginning of the 5th millennium BC) and the very end of the Eneolithic (5th millennium BC). This is the time of the so-called "unfulfilled civilization" of the Hamandjia culture and the Varna culture. The brilliant development of the late Eneolithic cultural block was terminated at the end of the 5th and the beginning of the 4th millennium BC by a colossal, global, and multi-causal environmental event. From the area of Varna Lake are known eight submerged settlements dated to the Late Eneolithic. These sites include large numbers of up to several decimeters thick, vertical poles, probably from permanent house constructions.

During the second half of the 4th millennium BC under the influence of the migration of nomads from Southern Russian steppes the important structure of the proto–Thracians was established. This is the Early Bronze Age (3200-2100 BC). From the area of Varna Lake are known thirteen submerged settlements dated to the Early Bronze Age.

Rezumat: *În timpul analizelor sistemului de așezări din zona Lacului Varna sunt cunoscute trei perioade de ocupare umană pe scară largă, de la Paleoliticul târziu până la Antichitatea târzie. Acestea sunt Eneoliticul târziu, Epoca Bronzului timpuriu și Antichitatea după Marea colonizare elenă.*

Coasta de vest a Mării Negre și în special Lacul Varna a atras omul din timpuri străvechi. Până în prezent, cele mai vechi urme ale șederii sale în această regiune sunt datate din Paleoliticul târziu (14000-12000 î.Hr.). În Mica Peșteră din apropierea orașului Beloslav, raionul Varna, au fost găsite unelte de silex din Paleoliticul târziu și oase de animale. Artefacte din Paleoliticul târziu au fost găsite și în timpul săpăturilor în zona Pobitite kamuni. La începutul Holocenului, Peninsula Balcanică de Est era aproape complet nelocuită; singurul sit mezolitic este cunoscut de pe malul vest-pontic. Acesta este locul Pobiti Kamuni, raionul Varna. Acest sit a scos la iveală numeroase microlite, din păcate fără stratigrafie, care aparțin perioadei cuprinse între mileniile IX și VIII î.Hr.

Perioada mai dinamică a dezvoltării umane în sud-estul Europei este granița dintre neolitic și eneolitic (tocmai sfârșitul mileniului al VI-lea î.Hr. - începutul mileniului al V-lea î.Hr.) și chiar sfârșitul eneoliticului (mileniul V î.Hr.). Acesta este timpul așa-numitei „civilizații neîmplinite" a culturilor Hamangia și Varna. Dezvoltarea strălucitoare a blocului cultural eneolitic târziu a fost încheiată la sfârșitul mileniului al V-lea și începutul mileniului al IV-lea î.Hr. printr-un eveniment de mediu colosal, global și multicauzal. Din zona lacului

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Varna sunt cunoscute opt așezări scufundate datate din eneoliticul târziu. Aceste amplasamente includ un număr mare de stâlpi verticali cu grosimea de până la câțiva decimetri, probabil din construcții permanente de case.

În a doua jumătate a mileniului al IV-lea î.Hr., sub influența migrației nomazilor din stepele rusești de sud, s-a stabilit structura importantă a proto-tracilor. Aceasta este epoca timpurie a bronzului (3200-2100 î.Hr.). Din zona lacului Varna sunt cunoscute treisprezece așezări scufundate datate în epoca timpurie a bronzului.

Keywords: *prehistory, geoarchaeology, submerged settlements*

Cuvinte-cheie: *preistorie, geoarheologie, așezări scufundate*

◈ Introduction

Over the last decades, earth scientists have accumulated a huge amount of information about geology, morphology, genesis, and development of seashores, which requires its automated processing. The role of the main factors that affect coastal dynamics has been investigated – the parameters of waves, currents, Black Sea level fluctuations, and conditions of feeding with silt. Solving the problem of these fluctuations and the genesis of sand bars of coastal lakes would significantly assist the completion of various controversial issues related to human occupation on seashores.

One of the most complicated topics is the hiatus between the final of the end of Late Eneolithic and the beginning of the Early Bronze Age. Potentially abrupt changes in sea level, an earthquake followed by a tsunami, or other natural disasters are among the possible reasons for putting an end to the brilliant Late Eneolithic society along the west Black Sea coast, especially in the area of Varna Lake. In a recent study, the Transitional period without human activities between these two epochs lasted *c.* 319 years and is connected with the increased Black Sea level after *c.* 5598 cal BP (Filipova-Marinova *et alii* 2016, p. 107).

◈ Physical and geological characteristics of the studied area

In the western part of the Gulf of Varna is situated the Varna Lake, which is a typical firth (fig. 1). Varna Lake is the largest by volume and deepest firth along the northern Bulgarian Black Sea coast with an area of 17 km^2, maximal depth of 19 m, and water volume of 166 million m^3. The lake is formed at the river valley after a rise of the Black Sea level during the Holocene. According to Filipova-Marinova *et alii* (2016, p. 104), lake formation started after *c.* 7870 cal BP due to an increase in the Black Sea level. Nowadays, it is separated from the sea by the constantly growing Asparuhovo sand spit (Dachev 2003).

The drilling surveys 650 m south of the naval channel reveal the rhythm of the Holocene sedimentation of the ancient valley. The river socle was discovered at a maximum depth of 51.4 m. There is a peat layer with a thickness of 0.6 m at a depth of 40 m which is covered by a layer of marine sediments with a thickness of 18 m. Above it, there is a 1.5 m peat layer and a 14 m sand layer mixed with shells and gastropods. Above these layers is situated the third peat layer (thickness 1 m) and accumulated clayey sand. The fossils at a depth of 33 m are close to modern and dated to the Holocene (Popov, Mishev 1974, p. 156, tab. 5) (fig. 2).

The substantial changes and irreversible shifts in the coastline and the natural hydro- and litho-dynamic regime of the bay occurred as an outcome of the intensified anthropogenic activities having took place in the 20th century. This basin was a fresh-water lake with a limited flow into the Black Sea, supplied by groundwater and inflowing rivers until it was modified to a brackish lagoon due to a connection with Varna Bay through an artificial channel after 1909 (fig. 3). The old Sea-Lake Canal has a depth of 5 m. The new one is dug in 1975, with a

depth of 12 m. As a result, the salinity of the water subsequently rose to 15-16‰. In 1923, Varna Lake was connected with the Beloslav Lake through digging a naval channel. Before these reconstructions, its height was no more than 1.4 m above sea level (Peev 2008, p. 261).

Fig. 1. Map of the area of Varna Lake (Google earth image).
Harta zonei lacului Varna (imagine Google earth).

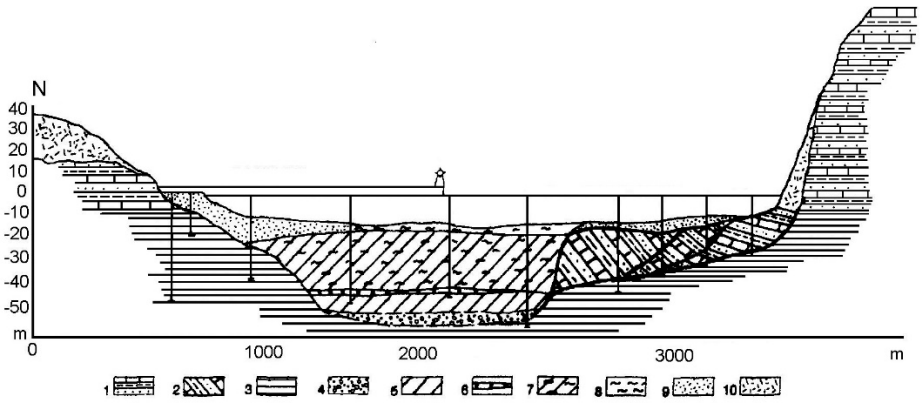

Fig. 2. Geological cross-section at the Jetty of Varna (after Evstatiev, Manov 1988). 1 – Neogene marls, limestones and sandstones; 2 – dragged down Neogene materials; 3 – Oligocene clays and argillite; 4 – Quaternary alluvial gravels; 5 – Quaternary alluvial clay; 6 – Quaternary buried peat; 7 – Quaternary aleurolite mud; 8 – Quaternary organic mud; 9 – Quaternary sea sands; 10 – Quaternary delluvial clay.
Secțiune geologică în zona debarcaderului Varna (după Evstatiev, Manov 1988). 1 – marne, calcare și gresii Neogen; 2 – materiale dragate Neogen; 3 – argile și argillite Oligocen; 4 – pietrișuri aluviale Cuaternar; 5 – argilă aluvială Cuaternar; 6 – turbă îngropată Cuaternar; 7 – mâl siltic Cuaternar; 8 – mâl organic Cuaternar; 9 – nisipuri marine Cuaternar; 10 – argilă deluvială Cuaternar.

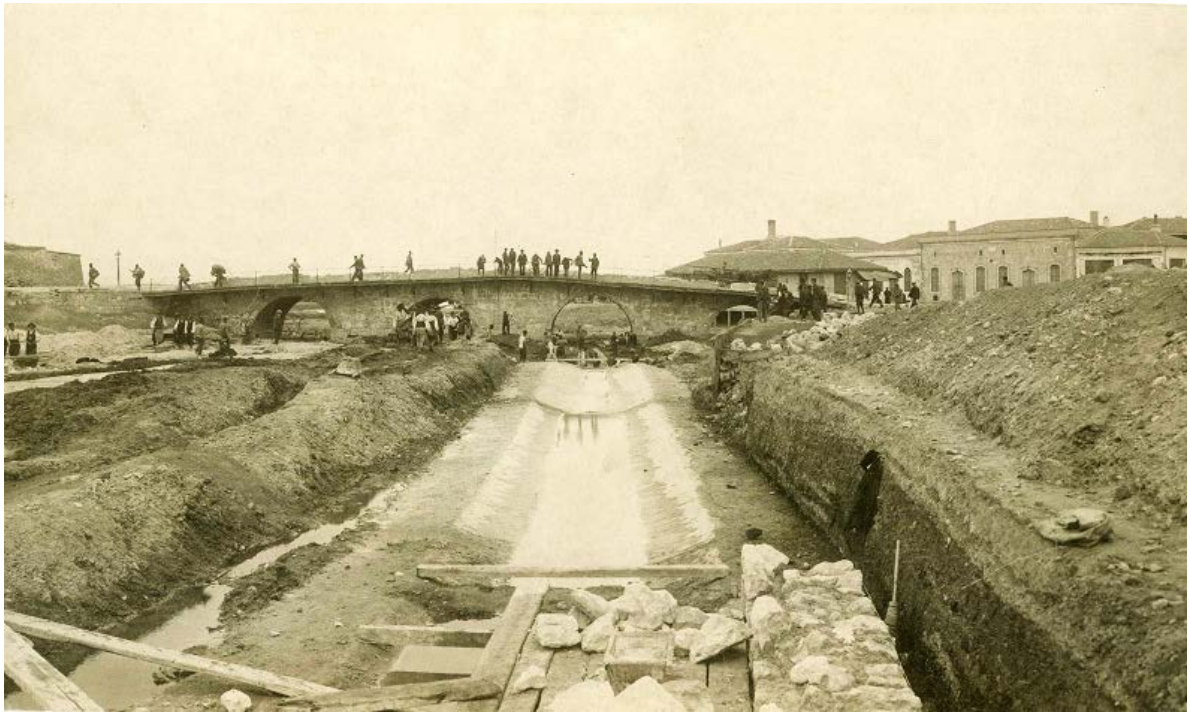

Fig. 3. Photo taken during the digging of the artificial channel.
Fotografie realizată în timpul realizării canalului artificial.

◈ Archaeological background

The Western Black Sea coast and especially Varna Lake has attracted man from the oldest times. Until now, the most ancient traces of his stay in this region are dated from the Late Palaeolithic (14000-12000 BC) (Todorova 1978, p. 1-2). Late Paleolithic flint tools and animal bones have been found in the Little Cave near the town of Beloslav, Varna district. Late Paleolithic artifacts have also been found during the excavation in the area of Pobitite Kamuni (Todorova 1995, p. 82-83). Also, in this area, is known the largest collection of Mesolithic artifacts in Southeastern Europe. Margos (1972) has found more than 12,500 tools and flint splits.

The prehistoric population found in this area everything that they needed for the development of the economy: soft, humid, and fat soils, fresh water, and rich game forests. This is the reason why during the Eneolithic time, the area of Varna Lake was the most densely populated territory along the west Black Sea coast.

The potential for the existence of Stone Age settlements in the Bulgarian sea territory extends to 110-120 m below the present water level. This low stand was reached during the latest ice age when the Black Sea was disconnected from the world ocean (Alekseev *et alii* 1986; Filipova-Marinova 2007).

Several submerged prehistoric settlements are known along the western coast of the Black Sea, and they have been defined in the scientific literature as 'lake dwellings'. Recently, some publications have made some timid attempts to revise this categorization (Peev 2004).

In the offshore of Varna–Beloslav Lake, there have been found 13 submerged settlements dated to the Eneolithic period and the Early Bronze Age at depths 6-9 m. No settlement has been found from an earlier period. The hypothetic earlier sites were covered with river/lacustrine deposits.

◈ Discussion

The Black Sea basin has undergone varying fluctuations in level and nature throughout the Quaternary. At various times in its history, when eustatic sea levels were low, the Black Sea became isolated from the global ocean system. The precise timing of these periods, the nature of the basin, changes in salinity and lake levels, and the subsequent process of transgression have been fiercely debated (Yanko-Hombach *et alii* 2007a; 2007b; 2011; Lericolais 2017; Yanchilina *et alii* 2017).

There are evidences that the Black Sea had been a fully enclosed freshwater lake during the last glacial maximum (~21000 BP) and for some time after (Peychev, Peev 2006, p. 19). Subsequent global sea level rise resulted in the Black Sea being abruptly connected to the Mediterranean Sea through the Dardanelles and the Bosphorus Straits and rapid submergence around the Black Sea coast (Peychev, Peev 2006, p. 21-22).

Reconnection with the Mediterranean has been put at dates ranging from 8.4 ka cal BP (Ryan *et alii* 2003) to 9.3 ka cal BP (Yanchilina *et alii* 2017) to 10.3-9.5 ka cal BP (Lambeck *et alii* 2007) and 9.6-9.2 ka cal BP (Nicholas *et alii* 2011) and it is still debatable.

Hence, the coastlines of the Black Sea have experienced large changes in sea level throughout geological history.

According to data from the Black Sea and the Mediterranean, sea level in 8-7 ka was more than 11 m below the present one (Peev 2014) (fig. 4). In the Franchthi Cave, Greece, at -11 masl, Neolithic artifacts dated 7610-7150 BP were found (Jacobsen, Farrand 1987). The same level is reached again at *c.* 6000 BP (Lambeck 1996). At the end of the Eneolithic period, there was only a small increase in the level of the Aegean, at approximately 1-2 m. In the Franchthi Cave, the level was 9 m below the present one, and along the southern coast of the Argolida peninsula, the level was 10 m lower (van Andel 1988). Gifford (1983) noted, in the Franchthi cave, cultural layers from the period 8300-7100 BP at the depth of 9 m below the present level.

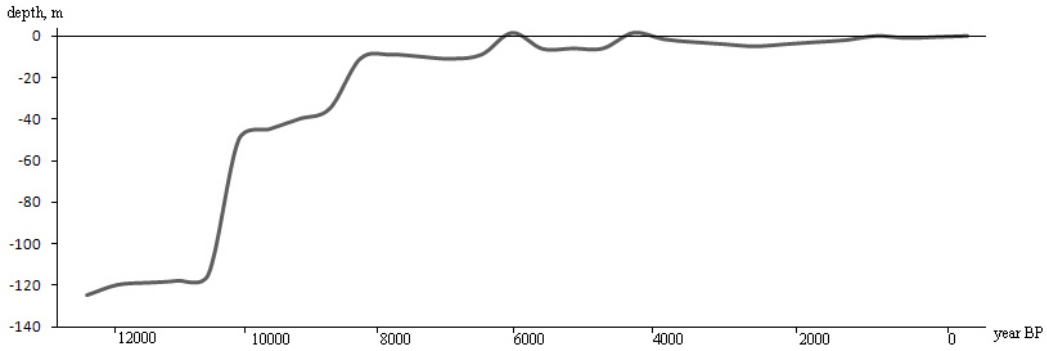

Fig. 4. Black Sea level curve during the last 12000 years (after Peev 2014).
Curba nivelului Mării Negre în ultimii 12000 de ani (după Peev 2014).

Data were obtained from the prehistoric necropolis off Cape Shabla, northern Bulgarian Black Sea coast (Peev 2009, p. 89). Two burial sites are present, the first at -6.5 m and the other at -3.5 m below the current one. These could be dated to the Late Neolithic or Eneolithic. Sea level along the Bulgarian coast was, at the time, at least 7 m lower.

The present Varna–Beloslav firth has been a vast sea gulf as such it has reached the mouths of the rivers Devnenska and Provadiyska. In reality, Varna and Beloslav are two lakes,

initially undivided, but as a result of the accumulation of deposits and decreasing of the river flow they had been divided into separated lakes.

All eighteen prehistoric settlements which have been found till now along the Bulgarian Black Sea coast are at a depth 6-9 m below present sea level (Ivanov 1993; Draganov 1995; Lazarov 1996). Thirteen of them have been found in the Varna-Beloslav Lake (fig. 5) (Ivanov 1993). Data do exist for other submerged settlements as well, where, unfortunately, no artifacts have been found.

The detailed analysis of existing results and data related to Black Sea level fluctuations show that all of these settlements (from Eneolithic and Early Bronze Age) were situated on the first unflooded river terraces, and not on wooden platforms or pilots (Peev 2004). This conclusion, to a great degree, determines the very characteristics of the habitations. Unfortunately, more sites have been destroyed during building and trawling work, which has presented difficulties for the excavators. But despite these challenges, the first excavators of the submerged settlements were entirely correct in identifying the presence of four stratigraphical layers (Margos, Toncheva 1962, p. 1-2, fig. 3). Later, excavations using the methods of underwater archaeology confirmed these observations (Ivanov 1987).

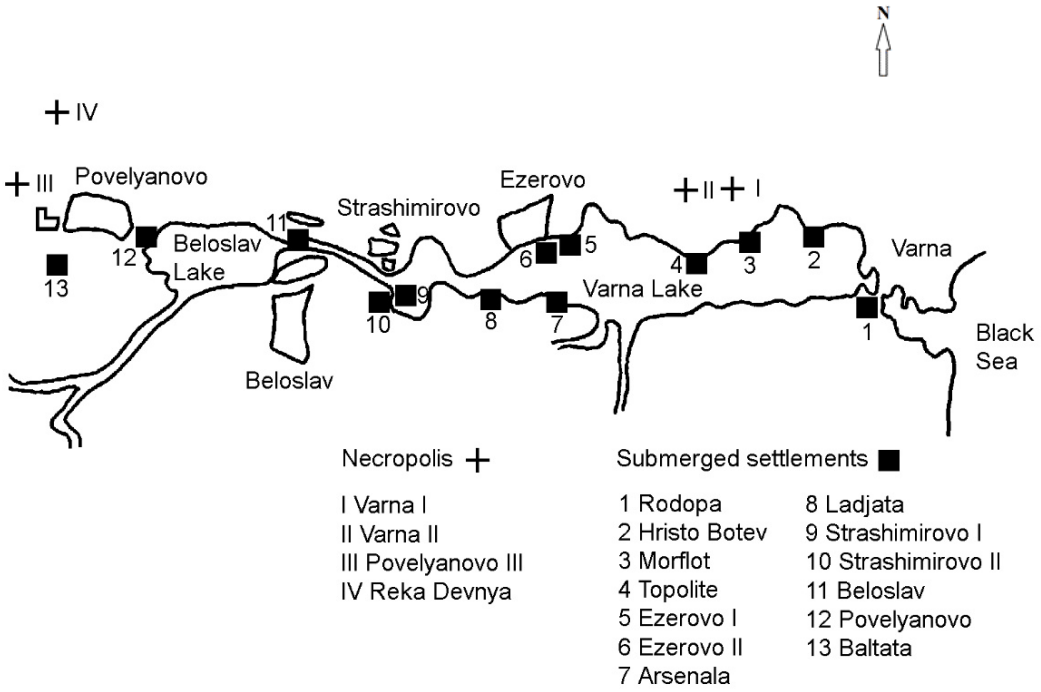

Fig. 5. Map of submerged settlements along the Varna–Beloslav firth borders (after Ivanov 1993).
Harta siturilor scufundate de-a lungul malurilor estuarului Varna–Beloslav (după Ivanov 1993).

Despite the fact that the prehistoric settlements from the Eneolithic and Early Bronze Age are found nowadays along the Black Sea shoreline, the geomorphological and stratigraphical analyses indicate that during their existence the sites were river settlements, situated at the mouth of lower river valleys.

This is proved by the fluctuation curves of the Black Sea levels between 6500-4000 BP as well (fig. 4). Since this position protected the settlements from the gales of the Black Sea,

they presented reliable trade centers for the exchange of artifacts came through sea trade with the inland areas. This underlines the fact that during these far-off times, people feared the storms of the sea and could not build structures that could protect them. Only the well-preserved estuaries of the rivers provided safety for prehistoric people, and thus they took shelter in the calmer and deeper inland gulfs (or lacustrine). L. Nikolova (1994) has adduced several facts and summarized the situation during the Early Bronze Age concerning sea contacts of population between South-Eastern Europe and North-Western Anatolia.

Along the coast of Varna–Beloslav Lake have been found the remains of eight submerged settlements from the second stage of the Eneolithic (Ivanov 1993). These sites correspond to so called Varna culture (Todorova 1995, p. 88) and one at the aquatory of Sozopol (Draganov 1995, p. 233-239). From the Varna–Beloslav Lake, only the Arsenala site has undergone underwater investigations, on a small area of 25 m² (Ivanov 1987). The major result of these studies was the identification of two cultural layers (Eneolithic and Early Bronze Age) without evidence of house horizons, but determined by the stratigraphy. This is a result of the fast rise in sea levels (fig. 4). The beams of the houses remained in situ and this led to the wrong conclusion that these beams were part of a wooden platform on which the ancient houses were built. Typical of the Arsenala site is the massive Early Bronze Age layer, which reaches a thickness of 3.5 m. Under this, an approximately 0.9 m layer is situated, which is rich in sea mollusks. No archaeological artefacts were found in this layer. However, the lower layer contained Eneolithic pottery, house beams and animal bones. The thickness of this lower layer is also around 0.9 m.

The pollen analysis of Filipova-Marinova *et alii* (2016) in Lake Varna shows two episodes of deforestation and cereal cultivation with an interval between re-afforestation and reduction in indicators of human influence. The first episode of deforestation is dated to 6140-5820 cal BP (4190-3870 cal BC), corresponding to the Late Eneolithic occupation at Arsenala. The second episode begins at 5500 cal BP (3550 cal BC) and corresponds to the middle of the Transitional Period, while the interval between lasted for 320 years and is consistent with the occupational hiatus at Arsenala associated with marine sediments (Peev *et alii* 2020, p. 402-403).

The sedimentary sequences and the related archaeological artifacts were examined through lithological analysis, a biostratigraphical analysis of the molluscan fauna, and an analysis of the geomorphological, archaeological, and radiocarbon data. Continental, liman, and marine facies conditions of sedimentation have been established by examining the sedimentary textures, stratigraphic and palaeoecological value of the molluscan subfossil fauna. This complex interpretation of data through different analyses allowed the highlighting of important stages in the palaeogeographical development of the Lake of Varna and the human adaptation to changes in the coastal landscape at the beginning of the Holocene (Hristova, Peev 2023a).

Furthermore, in comparing the Holocene stages with the archaeological periods, a remarkable coincidence with the changes in cultures is revealed (Cohen *et alii* 2013) (tab. 1). The dating of the sites with correlation of the stratigraphic, palaeogeographic and archaeological sequence in the eastern part of the Balkan Peninsula reveal a remarkable synchronicity in climate change and the change of archaeological cultures (Hristova, Peev 2023b, p. 356-357).

The depths of the cultural layers are between 6-9 m below the current level. The last investigations on the situation of the prehistoric sites (settlements and necropolis) along the western Black Sea coast unambiguously show that all of these sites were situated on the first

unflooded river terraces, and not on wooden platforms or pilots (Peev 2004, p. 164). Chronologically they belong to Varna culture (Todorova 1984, p. 41, 45-51) and existed till the end of 5th millennium BC. This proves unquestionably that during this period (4600-4100 BC) the Black Sea level was lower than the present-day one with at least 9 m.

Chronological scale, ka BP	International stratigraphic scale (Cohen *et alii* 2013)		Alpine stratigraphical scale	Transgressive-regressive cycles (Fedorov 2000)	Chronostratigraphic scheme of the Bulgarian shelf zone (Shopov 1993)		Archaeological period	Data range, cal BP
	Series	Stage						
	Holocene	Meghalyan	Subatlantic	Nympaean transgression	Black Sea stage	New Black Sea stage	Iron Age	1100-…
				Phanagorian regression			Bronze Age Late	3600-1100
							Middle	4550-3600
							Early	5150-4550
4.2		Northgrippian	Subboreal	Newchernomorian transgression		Old Black Sea substage	Trans. Period	5800-5150
							Eneolithic	6800-5800
			Atlantic	Oldchernomorian regression			Neolithic Late	7100-6800
8.2							Middle	7400-7100
		Greenlandian					Early	8450-7400
			Boreal	First influence of Mediterranean water			Mesolithic	12000?-8450
11.7			Preboreal					

Tab. 1. Principal subdivision of the climatic, palaeogeographical, and archaeological sequence in Bulgaria (after Hristova, Peev 2023b, p. 357, tab. 1).
Principalele subdiviziuni ale secvențelor climatice, paleogeografice și arheologice în Bulgaria (după Hristova, Peev 2023b, p. 357, tab. 1).

It is very likely these settlements or at least some of them have served as port centers. The people of the West Pontic cultures lived on the shore in direct contact with the sea and apparently used its capabilities for easier communication and relations.

The life in these most highly developed in the world for its time settlements have been suspended abruptly at the end of the Vth mill. BC. The first possibility is that it happened as a result of natural disasters and flooding of the settlements of the Varna culture. The evidence for the abrupt rising of the Black Sea level during the Late Eneolithic we found just in the submerged Eneolithic sites. At the dredging in the area of Varna Lake and during the underwater archaeological excavations of the Arsenala and Sozopol sites (Ivanov 1993; Draganov 1995, p. 233-239) have been found wooden beams with preserved bark and numerous tools and pottery (fig. 6). The last finds have been of great value. In case of the slow rise of the sea level, or if the settlements ceased to exist as a result of the invasion of the steppe tribes, who came from the north, people would be able to take with them.

Fig. 6. Pottery from the Arsenala site (photo: Archaeological Museum of Varna, 1987).
Vas din situl Arsenala (foto: Muzeul Arheologic din Varna, 1987).

◈ Conclusion

The Bulgarian Copper Age represents a socio-economic peak in European prehistory, and based on the archaeological material available it is suggested that this outstanding episode was characterized by coastal habitation of unprecedented scale and permanence. The very dynamic period for human presence in the area of Varna Lake has been proved by archaeological data as well as by different geological and palynological surveys.

Both underwater archaeological sites and palaeoenvironmental sequences provide a consistent picture of two phases of settlement on the Bulgarian coast between about *c.* 4400 and 2500 cal BC, the first associated with the Late Eneolithic period (*c.* 4450-3850 cal BC), and the second associated with the Early Bronze Age (*c.* 3200-2500 cal BC). There is some variation and margin of error in these date ranges, but all the evidence points to a hiatus in occupation along the Bulgaria coast, with the abandonment of settlements and the re-establishment of forested conditions. The length of this interval is debated, and more excavation and dating are needed.

◈ Acknowledgments

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◈ Bibliography

Alekseev *et alii* 1986	M. Alekseev, A. Chistyakov, F. Shterbakov, *Quaternary geology of continental outskirts,* Nedra, Moscow, 1986 [in Russian].
van Andel 1988	T. van Andel, The Adjacent Sea, in T. van Andel, S.B. Sutton (eds.), *Landscapes and people of the Franchthi region*, Indiana University Press, Bloomington, 1988, p. 31-54.
Cohen *et alii* 2013	K. Cohen, S. Finney, P. Gibbard, J.-X. Fan, The ICS International Chronostratigraphic Chart, *Episodes* 36, 2013, p. 199-204.
Dachev 2003	V. Dachev, Genesis and evolution of Varna Central Beach, *Proceedings of the Institute of Oceanology* 4, 2003, p. 74-82 [in Bulgarian].
Draganov 1995	V. Draganov, Submerged coastal settlements from the Final Eneolithic and the Early Bronze Age in the sea around Sozopol and Urdoviza Bay near Kiten, in D.W. Bailey, I. Panayotov (eds.), *Prehistoric Bulgaria*, Prehistory Press, Madison, 1995, p. 225-241.
Evstatiev, Manov 1988	D. Evstatiev, G. Manov, *Engineering geological characteristics of the valley of the Varna Lakes*, Bulgarian Academy of Sciences, Sofia, 1988.
Fedorov 2000	P. Fedorov, Effects of climatic events on the geological history of the Black Sea during the Pleistocene, *Stratigraphy and Geological Correlation* 5/7, 2000, p. 74-81 [in Russian].
Filipova-Marinova 2007	M. Filipova-Marinova, Archaeological and paleontological evidence of climate dynamics, sea-level change, and coastline migration of the Bulgarian sector of the Circum-Pontic region, in V. Yanko-Hombach, A. Gilbert, N. Panin, P. Dolukhanov (eds.) *The Black Sea Flood Question: Changes in Coastline, Climate, and Human Settlement*, Springer, Dordrecht, 2007, p. 453-482.
Filipova-Marinova *et alii* 2016	M. Filipova-Marinova, D. Pavlov, L. Giosan, Multi-proxy records of Holocene palaeoenvironmental changes in the Varna Lake area, western Black Sea coast, *Quaternary International* 410, 2016, p. 99-108.
Gifford 1983	J. Gifford, Core sampling of a Holocene marine sequence and underlying Neolithic off Franchthi Cave, Greece, in P. Masters, N. Flemming (eds.), *Quaternary coastlines and marine archaeology: Towards the prehistory of land bridges and continental shelves*, Academic Press, London, 1983, p. 262-282.
Hristova, Peev 2023a	R. Hristova, P. Peev, New data on palaeogeographical changes during the Holocene in the Varna Lake region, *Review of the Bulgarian Geological Society* 84/1, 2023, p. 79-86.

Hristova, Peev 2023b — R. Hristova, P. Peev, About the stratigraphic correlation of events in Holocene geoarchaeology, *Review of the Bulgarian Geological Society* 84/3, 2023, p. 355-358.

Ivanov 1987 — I. Ivanov, Underwater archaeological survey of settlement "Arsenala", *Archaeological discoveries and excavations in 1986*, Sofia, 1987, p. 281-283 [in Bulgarian].

Ivanov 1993 — I. Ivanov, Á la question de la localisation et des études des sites submérges dans les lacs de Varna, *Pontica* 26, 1993, p. 19-26.

Jacobsen, Farrand 1987 — T. Jacobsen, W. Farrand, *Excavations at Franchthi Cave, Greece. Franchthi Cave and Paralia: Maps, Plans and Sections*, Indiana University Press, Bloomington, 1987.

Lambeck 1996 — K. Lambeck, Sea-level changes and shore-line evolution in Aegean Greece since Upper Paleolithic time, *Antiquity* 70, 1996, p. 588-611.

Lambeck *et alii* 2007 — K. Lambeck, D. Sivan, A. Purcell, Timing of the last Mediterranean Sea–Black Sea connection from isostatic models and regional sea-level data, in V. Yanko-Hombach, A. Gilbert, N. Panin, P. Dolukhanov (eds.), *The Black Sea flood question: changes in coastline, climate, and human settlement*, Springer, Dordrecht, 2007, p. 797-808.

Lazarov 1996 — M. Lazarov, Sunken settlements along the Western Black Sea in the context of Pontic and Eastern Mediterranean history, *History* 1, 1996, p. 48-61 [in Bulgarian].

Lericolais 2017 — G. Lericolais, Late Pleistocene environmental factors defining the Black Sea, and submerged landscapes on the western continental shelf, in N. Flemming, J. Harff, D. Moura, A. Burgess, G. Bailey (eds.), *Submerged landscapes of the European continental shelf: quaternary paleoenvironments*, Wiley, Chichester, 2017, p. 479-495.

Margos, 1972 — A. Margos A, Mikroliti ot eneolitni selishta vuv Varnensko, *Izvestiya na Narodniya Muzei Varna* 8/23, 1972, p. 233–235 [in Bulgarian].

Margos, Toncheva 1962 — A. Margos, G. Toncheva, Prehistoric lake-dwellings near Ezerovo village, Varna region, *Bulletin de la Société Archéologique a Varna* 13, 1962, p. 1-16 [in Bulgarian].

Nicholas *et alii* 2011 — W.A. Nicholas, A.R. Chivas, C.V. Murray-Wallace, D. Fink Prompt transgression and gradual salinisation of the Black Sea during the early Holocene constrained by amino acid racemization and radiocarbon dating, *Quaternary Science Reviews* 30, 2011, p. 3769-3790.

Nikolova 1994 — L. Nikolova, Data about sea contacts during the Early Bronze Age in South-Eastern Europe (C. 3500/3400 – 2350/2250 B.C.), *Thracia Pontica* 5, 1994, p. 5786.

Peev 2004 — P. Peev, Submerged Settlements Along the West Black Sea coast. The Problem of Situation, in H. Dobrzhanska, E. Jerem, T. Kalicki (eds.), *The Geoarchaeology of River Valleys*, Archaeolingua, Budapest, 2004, p. 161-169.

Peev 2008 — P. Peev, Physic-geographical description of the Varna Bay, in *Varna in the middle ages. Part 1. From the 7th to 10th Century*, Zograf, Varna, 2008, p. 250-280 [in Bulgarian].

Peev 2009 — P. Peev, The Neolithisation of the Eastern Balkan Peninsula and fluctuations of the Black Sea level, *Quaternary International* 197, 2009, p. 87-92.

Peev, 2014 — P. Peev, *Palaeogeography of the harbor basins in the ancient maritime history and archaeology along the Western Black Sea*. Unpublished PhD thesis, Institute of Oceanology, Varna [in Bulgarian].

Peev *et alii* 2020 — P. Peev, R.H. Farr, V. Slavchev, M.J. Grant, J. Adams, G. Bailey, Bulgaria: Sea-Level Change and Submerged Settlements on the Black Sea, in G. Bailey, N. Galanidou, H. Peeters, H. Jöns, M. Mennenga (eds.), *The Archaeology of Europe's Drowned Landscapes*, Coastal Research Library 35, Springer, Cham, p. 393-412.

Peychev, Peev 2006 — V. Peychev, P. Peev, *Evolution of the Bulgarian Black Sea coast after the Early Holocene*, Slavena, Varna, 2006 [in Bulgarian].

Popov, Mishev 1974 — V. Popov, K. Mishev, *Geomorphology of the Bulgarian Black Sea coast and shelf*, Bulgarian Academy of Sciences, Sofia, 1974 [in Bulgarian].

Ryan *et alii* 2003 — W. Ryan, C. Major, G. Lericolais, S. Goldstein, Catastrophic flooding of the Black Sea, *Annual Reviews of Earth and Planetary Sciences* 31, 2003, p. 525-554.

Shopov 1993 — V. Shopov, Stratigraphy of Quaternary sediments from the Bulgarian Black Sea shelf, *Review of the Bulgarian Geological Society* 54/1, 1993, p. 83-97.

Todorova 1978 — H. Todorova, Investigations of the Neolithic and the Eneolithic in Longoza (the beginning of 6th - the end of 5th Millenium BC), *Bulletin du Musée National de Varna* 8/23, 1978, p. 1-9 [in Bulgarian].

Todorova 1984 — H. Todorova, Dobrudzha during Prehistoric Age, in *History of Dobrudzha*, Tome 1, Bulgarian Academy of Sciences, Sofia, 1984, p. 23-71 [in Bulgarian].

Todorova 1995 — H. Todorova, The Neolithic, Eneolithic and Transitional period in Bulgarian prehistory, in D. Bailey, I. Panayotov (eds.), *Prehistoric Bulgaria*, Prehistory Press, Madison, 1995, p. 79-98.

Yanchilina *et alii* 2017 — A. Yanchilina, W. Ryan, J. McManus, P. Dimitrov, D. Dimitrov, K. Slavova, M. Filipova-Marinova, Compilation of geophysical, geochronological, and geochemical evidence indicates a rapid Mediterranean-derived submergence of the Black Sea's shelf and subsequent substantial salinification in the early Holocene, *Marine Geology* 383, 2017, p. 14-34.

Yanko-Hombach *et alii* 2007a — V. Yanko-Hombach, A. Gilbert, P. Dolukhanov, Controversy over the great flood hypotheses in the Black Sea in light of geological, paleontological, and archaeological evidence, *Quaternary International* 167, 2007, p. 91-113.

Yanko-Hombach *et alii* 2007b — V. Yanko-Hombach, A. Gilbert, N. Panin, P. Dolukhanov (eds.), *The Black Sea Flood Question: changes in coastline, climate, and human settlement*, Springer, Dordrecht, 2007.

Yanko-Hombach *et alii* 2011 — V. Yanko-Hombach, P. Mudie, A. Gilbert, Was the Black Sea catastrophically flooded during the post-glacial? Geological evidence and archaeological impacts, in J. Benjamin, C. Bonsall, C. Pickard, A. Fischer (eds.), *Submerged prehistory*, Oxbow, Oxford, 2011, p. 245-262.