UPPER HOLOCENE CALCAREOUS NANNOPLANKTON OF THE NW BLACK SEA

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Abstract. The investigations focused on two profiles from the Black Sea, placed in front of the Portița Mouth and in the south-eastern part of the Sahalin Island. Up to 40 m water depth, the samples from the Portița profile contain only reworked Mesozoic and Cenozoic calcareous nannoplankton taxa. In the same profile, the bloom of the calcareous nannoplankton species *Emiliania huxleyi*, together with abundant benthic foraminiferal taxa, were recorded in the first 11 cm of sediments, at below 40 m water depth. All the samples collected in the SE of Sahalin Island contain only Mesozoic and Cenozoic reworked calcareous nannoplankton taxa; no marine assemblages *in situ* were remarked.

Key words: NW Black Sea; calcareous nannoplankton; paleoecology; Upper Holocene.

INTRODUCTION

During latest Quaternary glaciation, the Black Sea became a giant freshwater lake. The surface of this lake drew down to levels exceeding 100 m below its outlet. During the Early Holocene, around 7.000 years ago, an outstanding event took place in the Black Sea basin, which marked the end of the lacustrine phase of this basin and the onset of a marine anoxic regime, similar to the present day one. This dramatic event is due to the Mediterranean sea level rise to the Bosporus sill. Saltwater poured through this spillway to refill the lake and catastrophically submerged more than 100,000 km^2 of its exposed continental shelf (Lancelot *et al*., 2002).

Even if the scientific community generally agrees that the age of the important event is around 7.000 B.C. (*i.e*., Arthur and Dean, 1998; Lericolais *et al*., 2006, and the synthesis of the published data on this subject *in* Yanko-Hombach *et al*., 2006), the approach which led to this event is still under debate. There are two main hypotheses related to the shift of the Black Sea into a marine anoxic basin, 7.000 years ago. One theory states that a sudden transgression took place leading to the reconnection of the Black Sea with the Mediterranean Sea, throughout the Bosporus Sill and the Marmara Sea, (*i.e*., Ballard *et al*., 2000; Ryan *et al*., 2003, scientists who related this important rise of the sea-level to the prehistoric flood myths). The other theory indicates that the invasion of the salted Mediterranean waters into the Black Sea, 7.000 years ago, was a gradual event (Panin, 1997; Görür *et al*., 2001; Aksu *et al*., 2002; Yanko-Hombach e*t al*., 2006) – Fig.1.

The restoration of the two ways communication between the Black and the Marmara seas is marked by the occurrence of the coccolith ooze (Black, 1973; Arthur and Dean, 1998), representing blooms of the marine algae Coccolithophorid, which live at the surface waters. These marine algae (described in the scientific papers as coccoliths or calcareous nannoplankton) display a calcareous skeleton. They represent one of the most prolific phytoplankton groups from nowadays. Notably, the coccoliths occurred for the first time in the Earth history long time ago (in the Late Triassic – Bown, 1998). Since then, they were continuously diversified and adapted at new habitats, and hence they occupied new ecological niches. As they are a planktonic group (living in the 50 m surface water column), the coccoliths are very sensitive to the environmental changes, such as temperature, salinity, light, and dissolved CO_2. For this reason, coccoliths were intensively used for paleoecological, paleoclimatical and paleogeographical reconstructions, including the Romanian Black Sea offshore (Black, 1974; Melinte, 2006; Giunta *et al*., 2007). As they are at the base of the trophic chain, these micron organisms are of

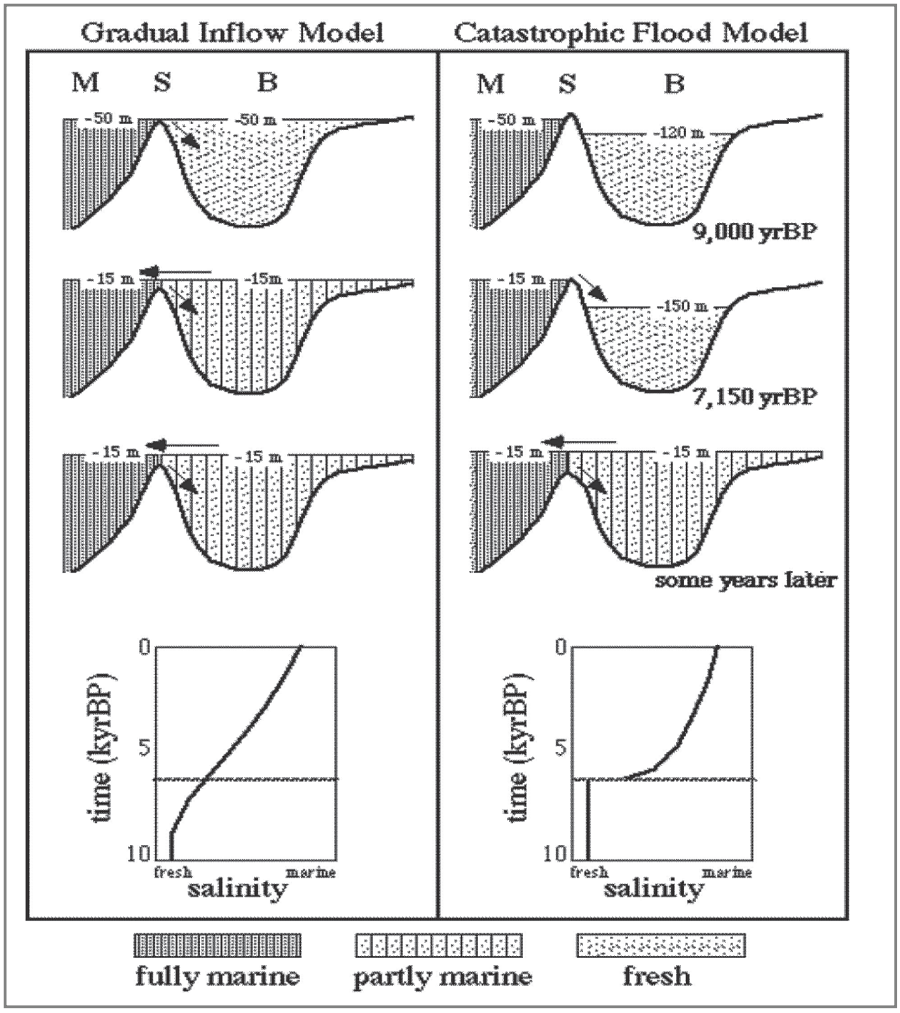

Fig. 1 The two models related to the shift of the Black Sea into a marine anoxic basin in the Upper Holocene (after Aksu *et al*., 2002)

prime importance to understand the evolution of the marine ecosystems. Nowadays, these algae (largely represented by the coccolith *Emiliania huxleyi*) are present in all the marine settings of our planet, yielding a remarkable abundance. In the present, one litre of water from the Black Sea surface contains around 40-50 million of *Emiliania huxleyi* cells (Lancelot *et al*., 2002). The coccolith species *Emiliania huxleyi* firstly occurred in the world ocean around 300,000 years ago, but its first appearance was identified in the Black Sea only 3,000 years ago (Bukry, 1974). Its late occurrence in the Black Sea indicates the moment when the salinity increases in this basin up to a value probably around 11%, which allows these algae to survive (Bukry, 1974; Oaie and Melinte, 2005; Giunta *et al*., 2007).

We aim herein to present our results on the paleobiotical assemblages identified in the NW Black Sea region (in an area placed around the Danube Delta front), in order to realise the Upper Holocene paleobiogeographic reconstruction. Paleoenvironmental interpretations are also advanced.

MAIN HOLOCENE LITHOLOGICAL UNITS OF THE BLACK SEA

One of the first detailed lithostratigraphical studies of the Black Sea Holocene deposits belong to Ross and Degens (1974), who identified (from younger to older): (1) the Coccolith-Ooze "Unit 1" (sedimented during the last 3000 years), (2) the Sapropel Muds "Unit II" (deposited within the 7100-3500 years B.C.), and (3) Neoeuxinic Muds "Unit III" (deposited within the 7100-7600 years B.C.). More recently, the investigations realised in the European Projects *EROS*, *Blason* and *Assemblage*, between the years 1998-2005, confirmed the presence of the three Holocene lithological units in the NW Black Sea (Panin and Jipa, 1998; Strechie *et al*., 2002; Oaie *et al*., 2005; Panin and Strechie, 2006; Lericolais *et al*., 2006; Popescu *et al*., 2006; Strechie-Sliwinski, 2007). The base of the Unit I of Ross and Degens (1974) was dated around 3000 years B.C. (*i.e*., 3450 years by Ross and Degens in 1974, and 3470 years after Strechie-Sliwinski in 2007).

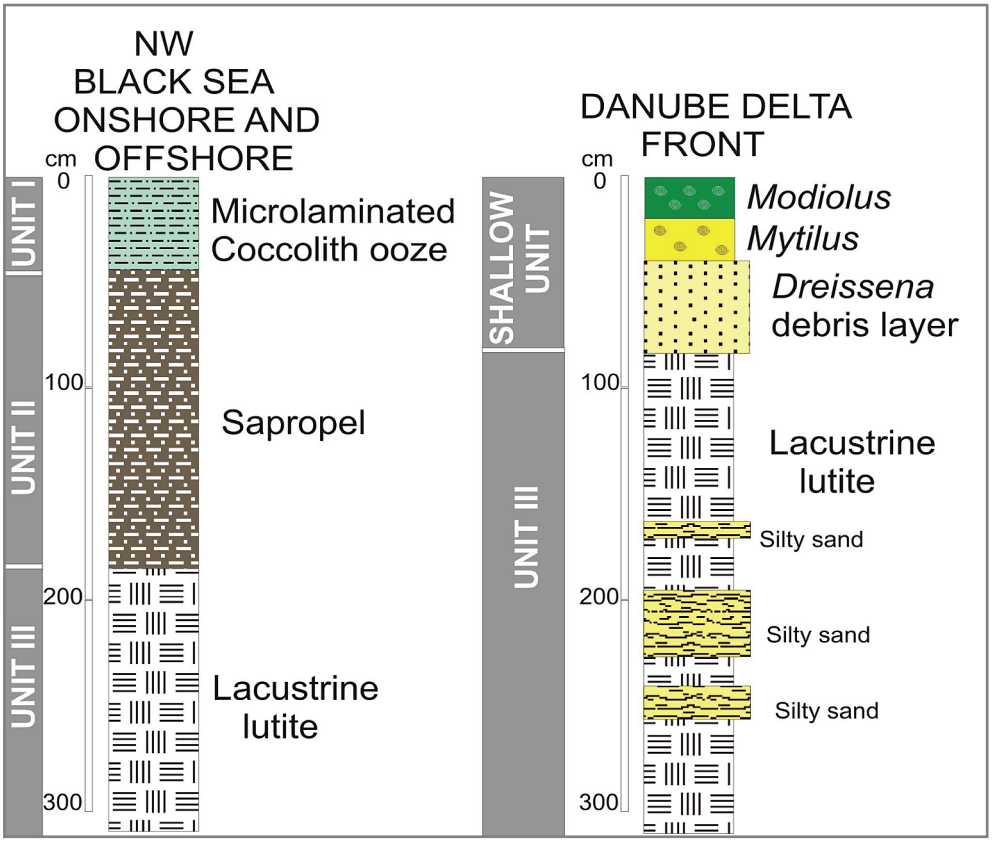

Fig. 2 Holocene lithostratigraphy of the NW Black Sea region (after Giunta *et al*., 2007)

Recently, Giunta *et al*. (2007) indicated that the succession of the three Holocene lithological units of the Black Sea offshore (such as the Lacustrine lutite "Unit III", the Sapropel "Unit II", and the Microlaminated Cocccolith ooze "Unit 1") are replaced, in front of the Danube Delta, by two lithological units (Fig. 2). The above-mentioned paper describes as a youngest lithological unit the "Shallow water Unit" (with *Modiolus*, *Mytilus* and *Dreissena* debris), which replaces the Microlaminated Cocccolith ooze "Unit 1" and the upper part of the the Sapropel "Unit II", directly overlying the Lacustrine lutite "Unit III".

SAMPLING

To study the Upper Holocene paleobiological fluctuations, two profiles from the NW Black Sea were studied (Fig. 3). One of them (PO in Fig. 3) is situated at the east of the Portița Mouth. Three locations (PO2, PO3 and PO4) were sampled from this profile. The other profile (MN 07-03 in Fig. 3) is placed towards SE in respect with the Sahalin Island.

METHODS

The samples collected were studied from nannofloral point of view. Smear slides for calcareous nannofossils were prepared using a decantation method. The 3-30 µm fractions were separated as follows: the heavy-fraction was allowed to settle for 3 minutes in a 45 mm water column and was removed, while the fine-fraction was saved for slide preparation after 45 minutes. Examination of the nannofossils was carried out using an oil-immersion-objective Nachet light-microscope at 1200 x magnification.

For foraminiferal investigations, samples disintegrated in solution of sodium bicarbonate were washed to obtain microfossils using sieves of 0.063 mm size. The microfossils were manually picked under binocular microscope.

PALEOBIOLOGY

In the Portița profile (PO2 and PO3 locations – Fig. 3), up to 40 m water depth, the calcareous nannoplankton assemblages contain reworked taxa from older Mesozoic-Cenozoic deposits. Particularly, Upper Cretaceous, Eocene and Lower Miocene calcareous nannofloral species occur frequently. Holocene taxa (including *Emiliania huxleyi*) were not observed in the assemblages.

The samples from PO4 location (below 40 m water depth) yielded the bloom of the calcareous nannoplankton species *Emiliania huxleyi* (Fig. 4). Very few reworked taxa (<5 % of the total assemblages), mainly composed of Upper Cretaceous and Eocene species, were observed. Besides the bloom of the calcareous nannoplankton species *Emiliania huxleyi*, the

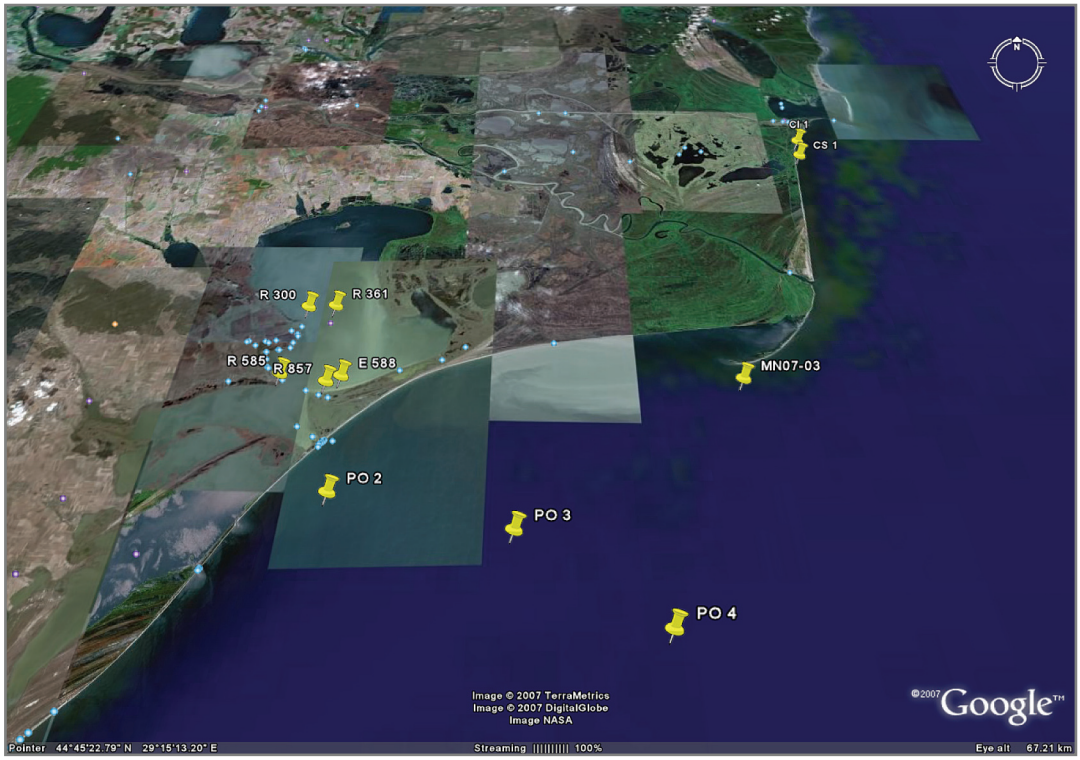

Fig. 3 Location of the studied profiles (PO - Portița; MN - SE of Sahalin Island)

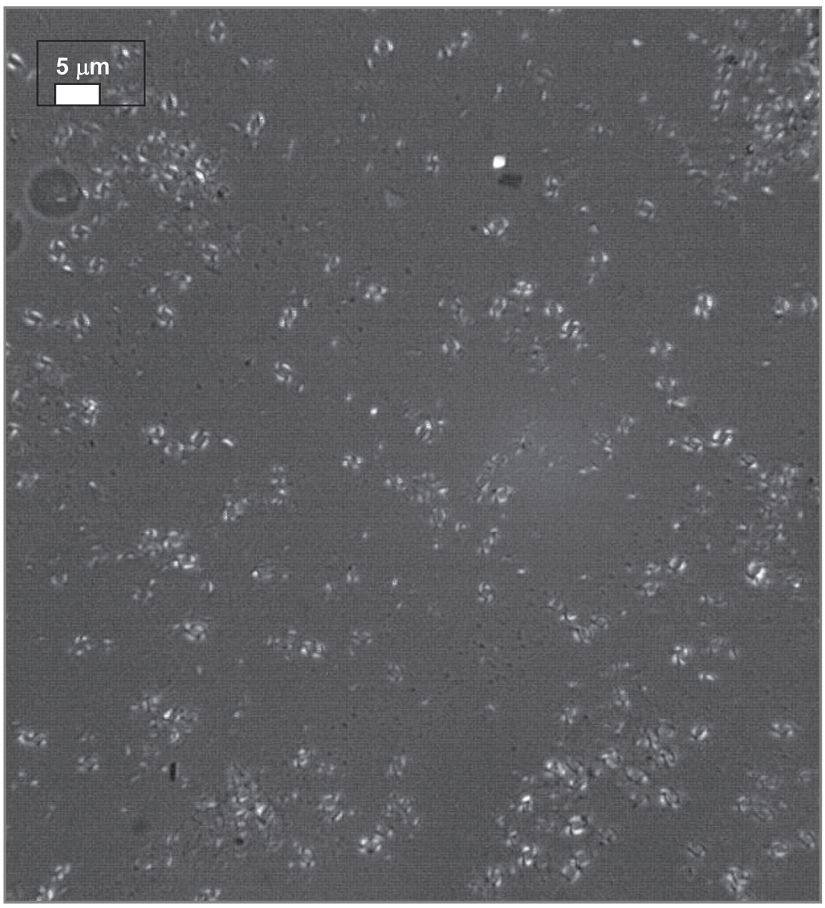

Fig. 4 Bloom of *Emiliania huxleyi* calcareous nannoplankton species in the Portița PO3 location

samples contain rich microfaunal assemblages, composed of formianifera such as *Ammonia beccarii* (LINNE), *A. viennensis* (d'ORB.*), A. tepida* CUSHMAN, *Cribroelphidium poeyanum* (d'ORB.) and *Porosononion* sp., ostracod taxa *Loxoconcha granulata* SARS, *L. lepida* STEPH., *Leptocythere gracilloides* SCHORNIKOV, *L. (Callistocythere) diffusa* (MULLER), and microgastropods

In the MN profile, at a sampling depth up to 300 cm, no Holocene calcareous nannoplankton *in situ* was observed. The collected samples exclusively contain older reworked Cretaceous, Paleogene and Neogene taxa.

CONCLUSIONS

The samples collected from the locations PO-02, PO-03 of the Portița profile, as well as from the MN profile (south of Sahalin) do not contain any calcareous nannoplankton taxon *in situ*, or marine micro-organisms such as foraminifers. The nannofloral assemblages contain a high number of reworked taxa from older Cretaceous, Paleogene and Neogene deposits. No specimen of *Emiliania huxleyi* was observed. This fact indicates a low salinity in the NW Black Sea, in front of the Portița Mouth, which does not allow the proliferation of the uppermost Holocene nannofloral taxon *Emiliania huxleyi*.

The samples collected from the PO-04 location (sampling in the sediment up to 11 cm, at a water depth below 40 m) revealed the bloom of *Emiliania huxleyi*. This bloom is similar with that recorded in the Microlaminated Cocccolith ooze "Unit 1" of deeper parts of the Black Sea.

We may assume that the PO-04 location was situated close to a (paleo-) shoreline, where a high salinity combined with an important nutrient input determined the remarkable proliferation of *E. huxleyi*. The salinity in the area where the PO-04 location is placed was high enough to allow the proliferation of the marine microfossils, such as the foraminiferal taxa *Ammonia beccarii* and *Elphidium* spp., encountered with a high frequency in this location.

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