A new method of sea level reconstruction based on particle size analysis of beach ridge plains

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In the current climate change conditions leading to accelerating sea level rise, it has become extremely important to understand the transformation of the coastal environment under the impact of aggressive eustatic, with a focus on the response of the lower coasts and especially deltas that are the most vulnerable coastal regions.

In order to be able to model and anticipate the effects of current eustatic, it is critical to know better (in more detail and more accurately) the evolution of sea level in the recent past, respectively in the Holocene, as well as the associated landscape changes.

The methodologies that determine the paleo-sea level currently use various level indicators, Sea Level Index Points (SLIP), but which remain extremely few, such as: (a) basal peat (supposed to form in lagoons and swamps whose substrate is very close to average sea level), (b) biological indicators (those species of foraminifera that support only very shallow depths or that live at known depths + species associated with seaports from different historical periods), (c) speleothems (which cannot directly quantify sea level, but may indicate a maximum level below which the sea surface was during their formation), (d) archaeological sources, (e) marine paleo-terraces. That is why it is necessary to improve the accuracy of these indicators, but also to develop new ones.

Our previous studies on the beach ridge plains of the Danube Delta (Preoteasa and Vespremeanu-Stroe, 2010; Vespremeanu-Stroe et al., 2016) showed that there is a definite link between the average sea level and the distribution of textural parameters (average-size, sorting, asymmetry and flattening) in sediments in the foreshore system, especially on the beach face. In the present study, we deepened this finding and took new vertical profiles (13) from beach ridge plains using an auger probe to describe the vertical distribution of textural parameters and to capture those indicators or changes that could be attributed to the presence of SLIPs, on a larger time scale. The dating of the sampling points is based on the interpolation of some OSL ages (from studies previously carried out by the team of the St. George Marine and River Research Station) on nearby beach ridges.

Figure 1 below shows the study area which consists of the Danube Delta, more precisely the beach ridge plains (from north to south) Letea, Saraturile and Saele.

The granulometry and Loss of Ignition (LOI) analyses were performed at the sedimentology laboratory of the Faculty of Geology within the University of Bucharest. Our results show that the particle size parameters change visibly. Thus, sorting is lower on the beach, especially in the lower-central part, while the content of inorganic carbonates usually increases near the average level and then up to about 15-30 centimeters below local sea level.

Visual observations in the field confirm this finding related to the carbonate content. We have preliminarily made a first draft of a sea level curve for the last 3500 years based on profiles, which show clear fluctuations in sea level during different climatic periods.
In the future, new samples will be needed from several locations in the beach ridge plains, in order to be able to develop and propose to the international community this new method of sea level reconstruction.

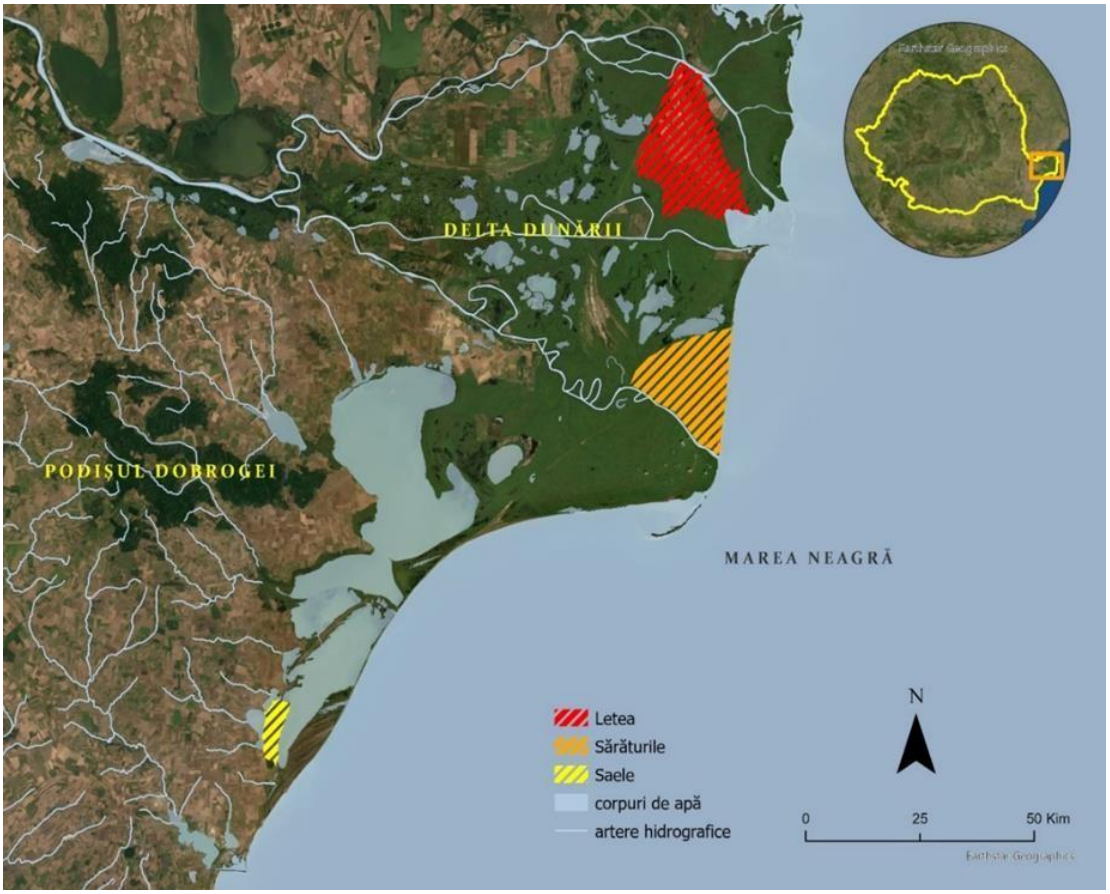

Figure 1 Study area showing from north to south Letea. Saraturile and Saele beach ridge plains.

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