Geochronology of Danube Delta sediments The PN-II-RU-TE-2012-3-0351 project

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Abstract
It is highly important to know the geochronology of the lakes and streams of the Danube Delta, in order to determine the sediment deposition rate. Several lakes are being investigated; physical parameters and radiometric dating are being applied in order to determine the sedimentation patterns and rates of deltaic sediments. The used radionuclides are ^{210}Po (^{210}Pb) for alpha-spectrometry with preliminary sample mineralisation and spontaneous deposition, and direct ^{137}Cs measurements using gamma-spectrometry. The sediment contaminations will also be analysed.
***Keywords**: Danube Delta, sediment, geochronology.*

INTORDUCTION

The aim of this study is to examine the sedimentation pattern of the Danube Delta as well as of the continental shelf lying in front of it based on radiological methods: ^{210}Pb, ^{137}Cs and ^{226}Ra. The evaluation of the sedimentation rates in fine-grained deposits from deltaic systems, costal zones and shelves is important because of the association with such deposits of chemical pollutants (Nittrouer et al., 1979, Michels, 1998) their impact on biological processes and their relationship on stratigraphic considerations, including changes in sedimentary environments (Jweda and Baskaran, 2011, Humphries, 2010)..

River deltas are the product of fluvial sediment supply and are reworked by waves and currents whose relative importance varies in space and time. The sedimentation process and the associated morphological changes in the Danube Delta along the deltaic coast are complex and less understood. The rates of sedimentation are continuously changing due to both natural and anthropogenic factors. Understanding the relation between the sedimentation process and the morphological changes within the Danube Delta and deltaic shoreline is a crucial step in predicting how the sedimentary system will evolve in the near future and in assesing its vulnerability to extreme events (Kuehl et al., 1982, 1986; DeMaster et al., 1985; Alexander et al., 1991; Harris et al., 1993).

From the total length of the Danube Delta Biosphere Reserve coastline 57% is erosive, 36% is prograding and 7% shows relative stability. Recent investigations yielded rates up to 20m/year of shoreline erosion in some sectors of the interdistributary Sulina-Sf. Gheorghe coast. Recent estimations show that between 1962 and 1992 the surface of the Danube Delta decreased with 22km^2.

Determination of the sedimentation rates both within the Danube delta and over the deltaic shelf is a major request in assessing the spatial – temporal pattern of the

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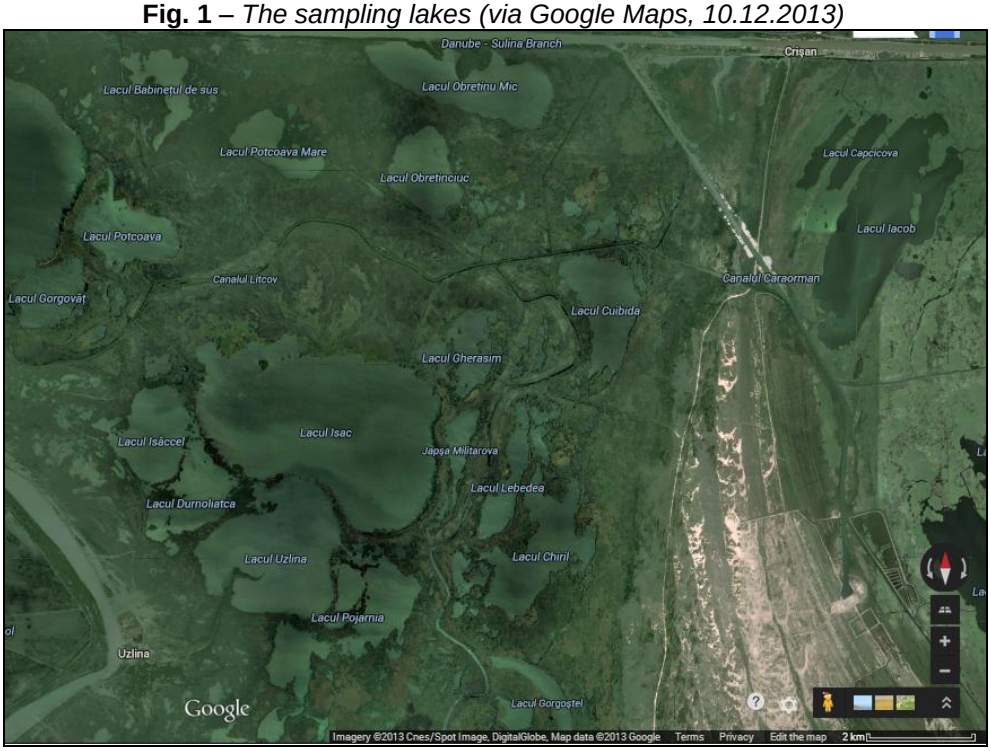
Danubian sediment dispersal. Sfantu Gheorghe arm mouth is not affected by any anthropogenic interventions such as jetties or other hydrotechnical work, its morphology being the expression entirely of the natural processes. This is why it is an ideal place to investigate the characteristics (rates and spatial distribution) of the river born sediment dispersal into the sea.
The difficulty of the problem is in the interpretation of the data which represents the sedimentation rates in the points where the samples were collected. The sedimentation rates from the delta can be influenced by two different modifications. The first change which leads to modification in the sedimentation rate is the shortening of the channels (St.Gheorghe from 109 to 69,7 km). As a consequence the water debits changes and leads to modifications in the transported sediment. The second change is due to the barrages built on the Danube. The two changes can be dissociated by choosing correctly the coring points.
Radiometric methods applications to Danube delta sediments can be found in the literature but those investigate the pollutant agents (heavy metals) in recent sediment layers. The accumulation rate of recent sediments from radiocesium profile was not estimated by using the ^{210}Pb methods (Dinescu and Duliu, 2001). The estimation based on radiocesium does not provide a good time resolution because it is reported on two maximum concentration peaks that can be found in sediment columns, one from 1963 (nuclear weapon test) and the second from 1986 (Chernobyl nuclear power plant disaster). A detailed study with high time resolution on the sedimentation pattern changes in the Danube delta was not made until now. The ^{210}Pb radiometric method which will be proposed in this project, aims to obtain that high time resolution data. By this we will be able to reconstruct all events that happened in the last 150 years in the Danube delta sedimentation processes, making it possible to differentiate between the anthropogenic influences and natural events. ^{210}Pb method was used in dating some sediment sequences from Black Sea (Ayçik et. al., 2004; Florea et.al., 2011) in order to investigate sediment rate and chemical composition.
The aim of this study is to present the phases of the ongoing research project regarding the Danube Delta stream sediments, as well as presenting a detailed state of the research at this moment.

STUDY SITE

The Danube Delta is the second largest river delta in Europe after the Volga Delta. Its approximate surface is 4152km^2 and it is part of the UNESCO World Heritage. The Danube branches into three main distributaries into the delta, Chilia, Sulina, and Sfântul Gheorghe. The last two branches form the Tulcea channel, which continues as a single body for several kilometers after the separation from the Chilia. At the mouths of each channel gradual formation of new land takes place, as the delta continues to expand. The sampling lakes were the following: Cruhlig, Cuibidia, Iacob, Isac, Matita, Merhei and Uzlina (Fig.1).

Fig. 1 – *The sampling lakes (via Google Maps, 10.12.2013)*



OBJECTIVES

One of the main objectives of the project is the determination of sedimentation rate in several lacustrine units from the Danube Delta area, lakes in which the sedimentation rate clearly reflects the variation of the river solid discharge. Undisturbed bottom sediments from several lakes form the Danube Delta will be extruded and the analysis of the vertical variation of the sedimentary facies combined with ^{210}Pb and ^{137}Cs radiometric methods will be undertaken in order to get a high resolution data of the sedimentation rates during the last two centuries. Additionally, sedimentation pattern in the proximity of the fluvial levees will be investigated for the first time at several locations in order to get insight into the lateral and temporal variations in sediment accumulation rates. This information is necessary for the quantification of the sediment volume changes at different times and the present tendency.

An other objective is the assessment of the sedimentation rates on the Danubian continental shelf. This investigation will identify the tendency of the sediment deposition rates offshore of the closure depths (inner continental shelf: -20…-50m) during the last century. More importantly, the main actual depocenters repartition and the associated sedimentation rates will be identified. This data, together with the data of sedimentation rates within the Danube Delta and the existing rates of

shoreline dynamics will give an account on the volume of the danubian sediments which exit the deltaic system. The sedimentation rates data will contribute to the analysis of the sedimentary linkage between the river discharge, the longshore currents and the shoreline dynamics in order to isolate and quantify the role of the river solid discharge contribution to the long shore transport and to the shoreline dynamics and river distributaries mouth changes.

The third objective is the geochronological investigation of the youngest deltaic lobes (Sfantu Gheorghe, Sfantu Gheorghe secondary delta, Chilia secondary delta by means of luminescence dating in order to obtain a high accuracy of their development rate. High resolution dating of the most recently formed Danube Delta lobes (e.g. post 3000 yrs) will be undertaken using Optical Luminescence Dating and ^{210}Pb and ^{137}Cs radiometric methods to get a detailed insight of the dynamics of the sedimentation processes involved in its evolution. Some data exist about the chronology and Danube Delta evolution. Additional geochronologic analysis of the morpho-sedimentaty units developed during the Late Holocene (e.g. last 3000 years) will be undertaken in order to determine the rates of the youngest deltaic lobes development. The presently missing data about the sediment availability at different times will be obtained. It is expected that the analysis of the sediment availability oscillations since the youngest deltaic lobes started to form will deliver a high resolution picture of the sedimentation events which will enable to distinguish between the natural processes and the anthropogenic impact on the sediment disposal and sedimentation rates. The comparative assessment of the past and present functionality of the deltaic system will enable us to evaluate the impact of the anthropogenic interventions in the Danube Delta development.

The last objective is to update and set up the necessary radiochemical and infrastructural means in our laboratories in order to measure a large number of samples. The study represents the first investigation of sedimentation rates and fluxes within the Danube delta and over the associated Danubian continental shelf, using the radiometric method of ^{210}Pb and ^{137}Cs. The detailed stratigraphical survey of the deltaic sediments will provide an accurate view of the deltaic geomophological evolution in the last 150 years, including the impact of the hydrotechnical works built within the Danube basin on the sedimentation pattern in the Danube delta and on the deltaic continental shelf. Another important aspect of the present project is featured by the alpha measurements of ^{210}Pb, through its daughter ^{210}Po. These measurements will be made in Romania, where only the alpha spectrometry laboratory from Cluj-Napoca have published data made on alpha spectrometry measurements of ^{210}Pb in sediments (Begy et.al, 2011). The alpha spectrometry has a number of advantages on measuring low-level activities, including high sensitivity, low intrinsic detector background, the elimination of the possible interference by chemical separation. Also, the use of a tracer makes the method more reliable. Worldwide laboratories have been utilized this technique for measuring ^{210}Pb in sub-recent deposits through its grand-daughter ^{210}Po. The project involves three complex radiometric and nuclear tools: alpha, gamma-spectrometry the determination of radionuclides of interest (^{210}Pb, ^{137}Cs, ^{210}Po and ^{226}Ra) and luminescence absolute method.

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