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INTERNATIONAL CONFERENCE ON RIVER-DELTA-SEA SYSTEMS

Celebrating 25 years of the National Research and Development Institute for Marine Geology and Geo-ecology – GeoEcoMar

ABSTRACTS

Bucharest, November 2018
GeoEcoMar

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National Institute for Marine Geology and Geo-ecology – GeoEcoMar birth and 25 years of activity

Academician Nicolae Panin

Honoured audience, your Excellences, ladies and gentlemen, dear colleagues!

Thank you for finding time and energy to participate at the 25th anniversary conference of the National Institute of R & D for Marine Geology and Geoecology – GeoEcoMar.

In 1993 I have taken the first steps to create the institute GeoEcoMar. Until then, at the Institute of Geology and Geophysics there was the Laboratory of Sedimentology and Marine Geology, the activity of which, due to the lack of specific infrastructure, especially of the research vessel, was limited to research in the Danube Delta, in the coastal area and to rare and short campaigns at sea, in the coastal sea, with leased and inappropriate small vessels.

What I will outline are things that are generally known, and please forgive me for lack of inventiveness and spontaneity, but these have been the basis for the initiative to create the GeoEcoMar Institute.

The fact that seas and oceans cover more than 70% of the Earth's surface and that resources on continents, on land, are becoming scarcer and difficult to access has made geological research focus also on the marine environment. New fields of oil and gas, unconventional energy resources, new sources of metals and raw materials (Seafloor Massive Sulphides, Manganese Nodules, etc.) indispensable for the further development of the world economy are uncovered in the sea. Significant progress has been made in the field of technologies for research, exploration and exploitation. The international legal framework governing these activities and the cooperation with the International Seabed Authority are also continuously improving. This creates the prerequisites for attracting the marine resources in the world economy allowing new developments and revolutions in the international economic and geo-political balance, a new world and new interests of countries.

Countries that are riparian of a sea or ocean and do not pay attention to this relatively new field of scientific research and sustainable use of marine resources considerably diminish the chances of having a prosperous and growing economy.

But let's go back in 1993. As I already mentioned, 25 years ago the Laboratory of Sedimentology and Marine Geology of the Institute of Geology and Geophysics had separated from the institute and became the Romanian Centre of Marine Geology and Geoecology that started up the adventure of survival and further development. From the beginning, I had the constant understanding and support of my colleagues who accepted the difficult moments of existence at the beginning, being always along with me. And we had also the help and the support of the

authorities, and first of all I refer to the Minister of Scientific Research at that time, Dumitru Doru Palade. I would like to thank him now for his opening of mind and for a clear vision of the future.

There followed the steps when the Centre caught roots and then grew. Quite quickly, in only three years of activity, the Centre met the qualification criteria as a national institute and thus, in 1996, the National Institute for Marine Geology and Geo-ecology – GeoEcoMar was born.

The adventures continued, one after another, the "Mare Nigrum" research vessel, the "Istros" fluvial and coastal sea research vessel, the "Halmyris" laboratory pontoon, buildings in Bucharest and Constanta, the specific marine research equipment and many more, and all of them during the period 1996 – 2006 and with the help and understanding of authorities – among them I would like to mention ministers Serban Valeca and Câmpurean, Gheorghe Popa, Anton Anton, Adrian Curaj and others.

The research activity, especially the international one, that began with a project performed together with Jean-Yves Cousteau for the study of the Danube River, the Danube delta and the adjacent coastal sea, continued and amplified over time, followed numerous European, national and bilateral projects with France (especially with IFREMER, Dr. Gilles Lericolais), Germany (University of Hamburg, Prof. Kin How Wong), Italy (Institute of Marine Geology in Bologna, Dr. Franco Marabini), Switzerland (Forel Institute, Prof. Janusz Dominik) and other distinguished scientists and institutes from different countries as well as with different international companies.

An exceptional performance of GeoEcoMar was the participation in European Projects called "European River - Ocean Systems" EROS 2000 and EROS 21, under the coordination of Professor Jean-Marie Martin.

In 1994, the idea of creating an international, modern and complex International Laboratory (Centre) in the Danube Delta was defined. The Research Minister of that time, Doru Dumitru Palade, supported the idea from the beginning. In 1995, the Minister Palade and I we had a meeting in Paris with the Commissioner for Science, Research and Development, Mrs Edith Cresson. The idea was accepted in principle, and Mrs Cresson recommended submitting a well-documented project in order to obtain EC financial support.

Following this visit, Palade obtained from the local authorities (Murighiol Council Decision No.20/ 18.10.1996) a land of approximate 15 ha for creating the International Research Centre for Life and Earth Sciences. The land was given in administration to the National Institute for Biological Sciences. Then, in 2006 the Murighiol Council reduced the area to 10 ha.

In 2002 GeoEcoMar obtained the status of European Centre of Excellence for the advanced study of river – sea systems: case study Danube River - Danube Delta - Black Sea (EuroGeoCentre - Romania, contract EVK 3-CT-2002-80006 for 2003-2006 period).

At the same time (2006) the idea of creating the International Centre for Advanced Studies for Life and Earth Sciences of the Danube-Black Sea system was concretized.

Thus our epopee, which is now called DANUBIUS-RI, was launched. The project aims at developing a Pan-European distributed research infrastructure for advanced study of river-sea systems in entire Europe.

With the help of the Romanian Academy, namely of Academician Cristian Hera, Vice President of the Academy, we succeeded to obtain from the Government of Romania a declaration stating the project as a "Strategic National Priority Project" and also a letter of commitment signed by the Prime-Minister for structural funding and national co-financing of the project amounting to 150 million Euros; the European Union Strategy for the Danube Region (EUSDR) considers it a "flagship project", and the European Strategic Forum for Research Infrastructures (ESFRI) accepted it on its roadmap for 2016.

We have reached the stage of elaborating the Feasibility Study and technical projects in order to be able to present to the European Commission the application for a major project with two-stage financing for achieving the Romanian components of the DANUBIUS-RI project: the Hub at Murighiol, the Supersite Danube Delta – the natural laboratory for studying and experimenting within the delta and the Data Centre, located in Galati, conceived for all 12 river-sea systems that are in the Pan-European project.

Time passes fast: 1993 seems to be the day before yesterday and 2009 yesterday. About 1993 we have already spoken. The year 2009 is the year when I handed over the GeoEcoMar to my younger colleagues, first Gheorghe Oaie - general director and Adrian Stănică - scientific director, then, after the so unexpected, premature and regretted disappearance of Gheorghe Oaie, Adrian Stănică - general director and Mihaela Melinte – scientific director.

Adventures, as I call our actions and achievements, are not over and I hope they will not end long.

Besides the DANUBIUS-RI project, the GeoEcoMar Institute was still the initiator of large-scale actions in the Black Sea and in the Danube River region. Among these, I will remember the project "Black Sea Security System" - a system designed to alert in real time the authorities and communities in the coastal zone in the event of phenomena that could endanger the security of the population and of economic and social objectives. The system provides also a real-time monitoring of the dynamics and of the quality of the Western Black Sea water masses, as well as information on the vertical (subsidence, compaction, up-lift) and horizontal dynamics (Plate dynamics) of the Earth Crust in the coastal area and the monitoring of the seismic movements in the area. Thereby GeoEcoMar have entered the Global Ocean Observation System (GOOS) and EMSO Eric (European Multidisciplinary Seafloor and Water Column Observatory).

The GeoEcoMar Institute is trying to create a new, modern marine research infrastructure to expand the research area - the Mediterranean Sea, other seas, perhaps the Ocean. GeoEcoMar will be, I am sure, an active member of the international oceanographic community, accepted and appreciated by the partners, thus assuring the presence of Romania in the worldwide effort to know and capitalize on the marine resources.

I will end up wishing the GeoEcoMar Institute great success in activity, long life and great achievements that will contribute to the progress of science and of the country.

Many happy returns of the day, GeoEcoMar!

Mapping activity on the Romanian Black Sea shelf: the state of the art

Mihaela C. Melinte-Dobrinescu, Nicolae Panin, Dan Secrieru, Gheorghe Oaie

National Institute of Marine Geology and Geo-ecology - GeoEcoMar

The geological-sedimentological mapping of the Black Sea continental shelf started in 1971 by the team of the Marine Geology Laboratory, a new department of the Romanian Institute of Marine Research, created and headed by the now Academician Nicolae Panin. The mapping related activities were done in the framework of the project *Identification of the mineral resources from unconsolidated sediments from the Black Sea continental shelf* and continued until August 1975, when the entire laboratory was transferred to the Romanian Institute of Geology and Geophysics (now The Geological Institute of Romania). Hence, the mapping of the continental shelf continued on sectors delimited by littoral landmarks (ex., the Chilia-Cap Midia Sector) and gradually extended to the limit of the continental shelf, at water depths of 120-150 m. In 1978, the geological-sedimentological mapping was supplemented with bathymetric, magnetometric and gravimetric mapping.

From 1987, the mapping of the Black Sea continental shelf activities were integrated in the general activity of the Institute, targeted at the geological mapping of the entire Romanian territory. As a result, the accumulated information supplemented with new ones, has been employed for realizing multidisciplinary 1:200,000 and 1:50,000 maps of the continental shelf according to the structure and nomenclature of the respective geological maps.

In 1993, the Marine Geology Laboratory separated from the Institute of Geology and Geophysics as The Romanian Center for Marine Geology and Geo-ecology that became later in 1996 the National Institute of Research and Development for Marine Geology and Geo-ecology - GeoEcoMar. The mapping activities continued in the new institutional frames; by the year 2003 the mapping of the continental shelf at 1:200000 was finalized (8 sheets) and 29 sheets of detailed 1:50,000 geological-sedimentological, bathymetric and magnetic maps were realized. Since 2003, the detailed mapping continued at a rhythm of one 1:50,000 sheet per year at the moment the mapping being almost completed up to the 30°E meridian.

As no specialized research vessel was available before the year 2005, the activities on the Black Sea performed in the interval 1971-2005 were done using several ships, some of them quite old and most of them hardly adequate for scientific work, therefore offering poor quarters for the scientific crew.

Among the ships used over the years, one can count Mangalia, Gilortul, Poarta Alba – a steam harbor tug-boat, Chilia etc. Most useful and used were the ships from the Naval Intervention and Rescue Group – Moldova and the rescue tug Viteazul (Fig.1).

Fig. 1 - Rescue Tug *Viteazul*
(Source: http://www.rmri.ro/EU_2850/Images/viteaz1.JPG)

It was a kind of "heroic period", often with difficult, sometimes dangerous situations and "safety first" was never heard of at the time. The scientists and technicians working at sea in those years had repeatedly to show plenty of ingenuity and dedication to carry out investigations with inadequate equipment. In 2005, after a very long and difficult struggle for funding the marine research, an old ocean going trawler "Someş" became R/V *Mare Nigrum* (Fig. 2), the first Romanian true multipurpose research vessel. Continuously improved and outfitted with modern navigational and scientific equipment, the scientific vessel *Mare Nigrum* has proved itself over the last decade the main assets of GeoEcoMar and a *sine qua non* of the Romanian marine research.

Presently, a multidisciplinary approach of marine investigations, consisting of geological studies (lithological, sedimentological, mineralogical), geophysical (bathymetry, magnetometry, gravimetry, seismic) as well as microbiology (ostracods, foraminifers and calcareous nannoplankton), as well as macrobiology (mainly benthos, including habitat mapping) is realized.

Fig. 2 – Research Vessel *Mare Nigrum* (Photo Adrian Popa)

Submarine Archaeological Heritage of the Western Black Sea Continental Shelf, a pioneering initiative of NIRD GeoEcoMar

Glicherie Caraivan

National Institute of Marine Geology and Geo-ecology - GeoEcoMar

1. Introduction

Starting from the times of the Neolithic times, followed by the Thracians and Geto-Dacians local communities, and continuing with the Greek, Roman, Byzantine and the Ottoman domination periods, until obtaining the state independence, Dobrogea and its harbours knew periods of blooming and also decline.

The colonization campaign of the western pontic coastline was done especially by the sea, the ancients being very good sailors. Traces of the trail followed by them, as well as of their established settlements, are found today both on land and on the bottom of the sea as well.

All these vestiges represent an archaeological cultural heritage, which we have begun to investigate.

Terminology

Taphonomy: science of burial in the general sense, process of burial and subsequent preservation or deformation of all type of material including inorganic artefacts.

Geoarchaeology may be similar, but it uses geological, sedimentological, geomorphological and geophysical methods to identify and describe an archaeological site on land or submerged landscape.

2. European/ Romanian Legislation on Underwater Heritage:

The UNESCO Convention on protecting underwater cultural heritage, adopted on 2nd November 2001, is the international treaty targeting the safeguarding of underwater cultural heritage.

Underwater cultural heritage means all traces of human existence having a cultural, historical or archaeological character which have been partially or totally under water, periodically or continuously, for at least 100 years.

The objectives and general principles of the UNESCO Convention are: to provide and improve the protection of the underwater cultural heritage.

The convention encourages responsible non-intrusive access to observe or document in situ underwater cultural heritage, to create public awareness, appreciation, and protection of the heritage.

In Romania, the UNESCO Convention on protecting underwater cultural heritage was adopted through the **Law no. 99/2007.**

As a result, the Romanian continental shelf was declared entirely as an archaeological site.

All the works that take place in this area and which may have an impact on the submarine archaeological heritage, must obtain a favorable Permit from the Ministry of Culture.

3. Background:

- **COST Action TD0902 SPLASHCOS**

(Submerged Prehistoric Archaeology and Landscape of the Continental Shelf)
2010 – 2013 COST Action TD0902 SPLASHCOS

- **Projects:**
- **Project : SUBMARINE ARCHAEOLOGICAL HERITAGE OF THE WESTERN BLACK SEA SHELF " HERAS"**

MIS-ETC-CODE 578

TOTAL VALUE : 1,197,414.74

Period of implementation: 2013-201

Lead Partner: GeoEcoMar

Partners: MINAC, IO-BAS, Kavarna Museum, Respiro NGO

- **Project: Western Black Sea Underwater Cultural Tourist Routes**

Financed by EU-DG MARE –EASME

Total Value: 150.000 Euro

Implementation: 1.01. 2017 – 1.05. 2018

Lead beneficiary NIRD GeoEcoMar

Partners: MINAC, IO-BAS, 2 SME's

Project: Western Black Sea Underwater Cultural Tourist Routes
Financed by EU-DG MARE –EASME
Total Value: 150.000 Euro

Implementation: 1.01. 2017 – 1.05. 2018

Lead beneficiary NIRD GeoEcoMar

Partners: MINAC, IO-BAS, 2 SME's

4. Geoarchaeological methods and data

Field investigation;

Laboratory analyzes:

Texture – sieving and pipetting

Mineralogy

Mollusk fauna

AMS C14 absolute age data (IFIN HH)

5. Interpretation: tables, graphics, cross sections

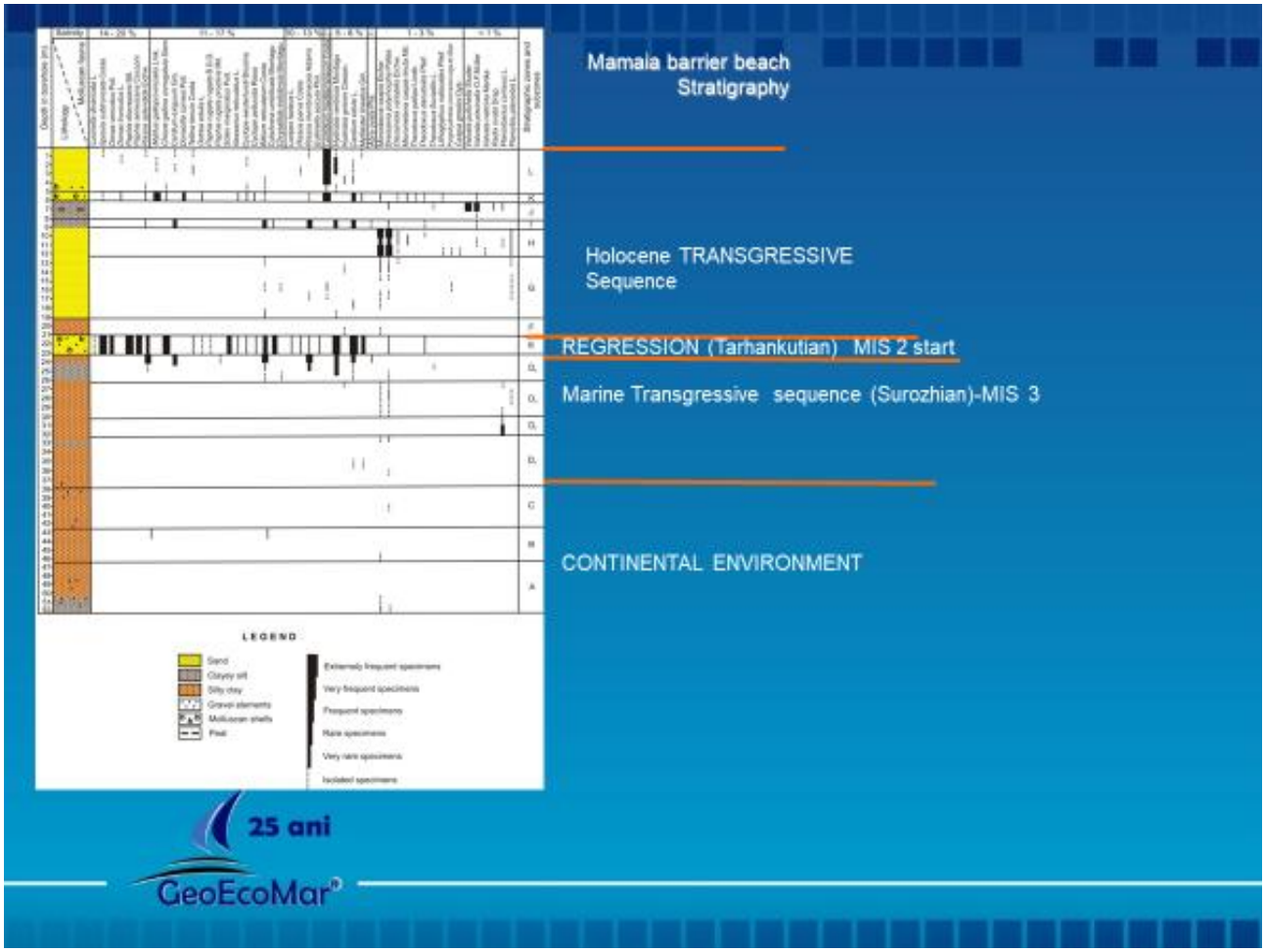

Figure 1. Mamaia barrier beach stratigraphy.

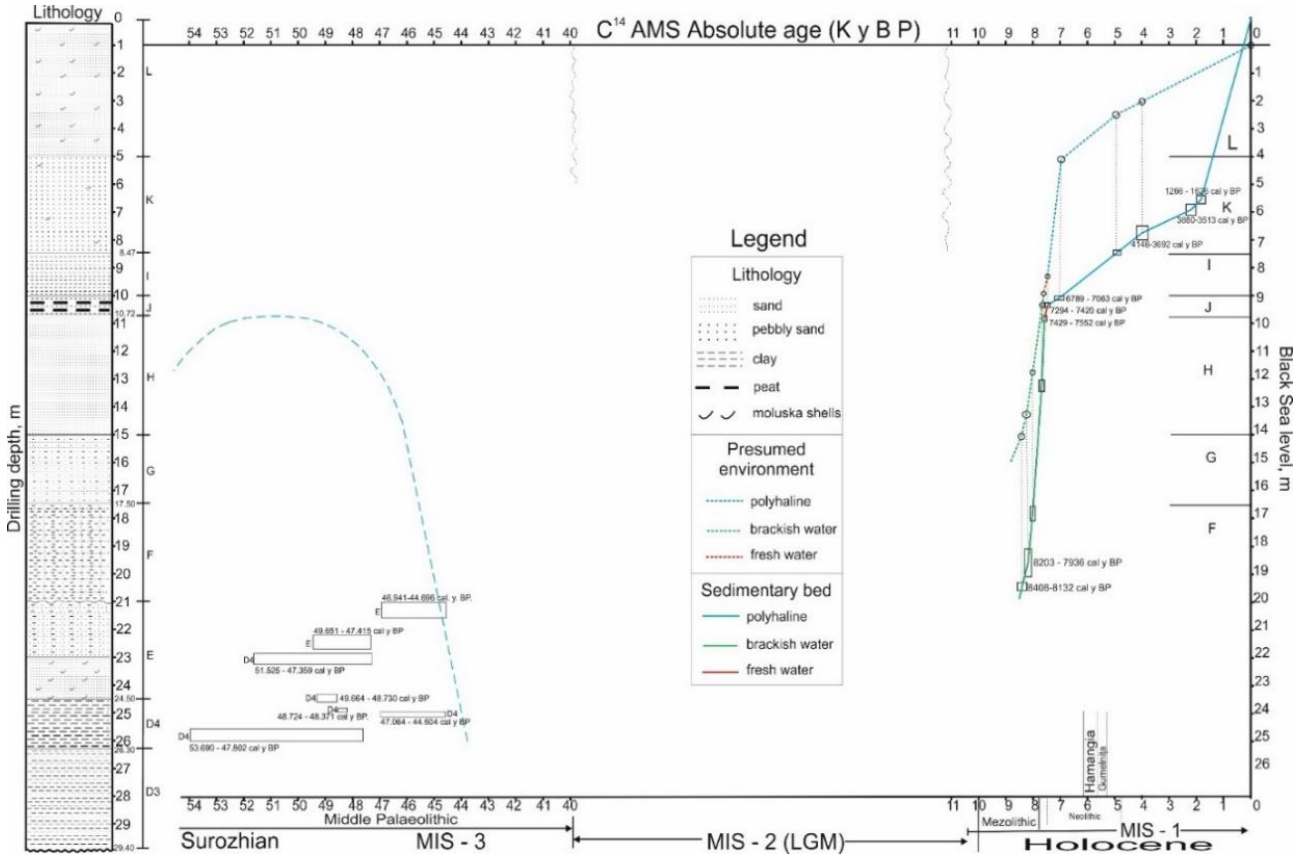

Figure 2. Black Sea level changes in the last 50,000 cal y BP.

5. Conclusions

The cyclic changes of the Black Sea level during the Upper Quaternary induced drastic changes of the shoreline configuration.

The oldest marine deposits found in the drill holes made on the barrier beaches and in the cores taken on the shelf belong to the „Surozhian strata" (MIS 3), when the Black Sea level was about 10 m below the actual one.

During LGM (MIS 2), the shoreline retreats eastwards, reaching the 100-120 m isobaths, therefore the recent shelf and Bosporus - Dardanelles straits remained exposed. This process enabled the migration of the prehistoric human communities from Asia to Europe, who established on the newly created alluvial plain from the Black Sea western shelf. The Holocene Transgression (MIS 1) determines the sea level rise up to the actual one.

The mean rate of sea level rise was about 20 cm in 100 years, probably higher in the Atlantic Period (Climatic Optimum, 4800-7400 y.B.P.).

Under the pressure of these environmental changes, the Neolithic settlements slowly retreated to the Dobroudjan river mouths. That's why traces of these communities are found mainly along

the borders of coastal lakes, and explains the scarcity of the Neolithic settlements on the adjacent shelf.

During the Antiquity times, the great sedimentation rates in deltaic area, and erosional processes in the southern part of the Romanian Black Sea have determined the extinction of the oldest Greek and Roman cities.

6. References

Banu, A.C., 1969. Preuves historiques sur les oscillations du niveau de la Mer Noire pendant les cinq derniers millenaires. Rapports et Proces-verbaux des Reunions. Commission Internationale pour l'Exploration Scientifique de la Mer Mediterranee 19(4): 617-618.

Caraivan, G., 2010. Studiul sedimentologic al depozitelor de plaja si de selful intern al Marii Negre între Portita si Tuzla. [Sedimentological Study of Beach and Inner Shelf Romanian Black Sea Deposits]. Ex Ponto, Constanta. (In Romanian)

Caraivan, G., Fulga, C., and Opreanu, P., 2012. Upper Quaternary evolution of the Mamaia Lake area (Romanian Black Sea shore). Quaternary International 261: 14-20.

Caraivan G., Opreanu P., Voinea V., Pojar.I, Giosan L., 2016. Holocene landscape changes and migration of human communities in the western part of the Black Sea (Mamaia Lake area).

Peev, P.I., 2009. The Neolithisation of the Eastern Balkan Peninsula and fluctuations of the Black Sea level. Quaternary International 197(1-2): 87– 92.

Shcherbakov, F.A., Koreneva, E.V., and Zabelina, E.K., 1977. Stratigrafiia pozdnechetvertichnykh otlozhenii Chernogo moria [Stratigraphy of the Late Quaternary deposits in the Black Sea]. In Pozdnechetvertichnaia istoriia i sedimentogenez okrainikh i vnutrennikh morei [Late-Quaternary History and Sedimentogenesis in Marginal and Inland Seas]. Nauka, Moscow, pp. 46–51.

Voinea, V., 2004-2005. Cauze privind sfârşitul eneoliticului în zona litoralului vest-pontic. Aşezarea de pe Insula La Ostrov, Lacul Taşaul, Năvodari, [Causes regarding the end of the Eneolithic in the western Black Sea coastal area. Lake Tasaul Ostrov Island settlement]., Pontica 37-38: 21- – 46.

Yanko-Hombach, V.V., 2007. Controversy over Noah's Flood in the Black Sea: Geological and f oraminiferal evidence from the shelf. In Yanko-Hombach, V., Gilbert, A.S., Panin, N., and Dolukanov, P.M. (eds.), The Black Sea Flood Question: Changes in Coastline, Climate and Human Settlement. Springer, Dordrecht, pp. 149-203.

Main results of the marine gravity and magnetic researches carried out at the National Research & Development Institute for Marine Geology and Geoecology

Radu G. Dimitriu

National Institute of Marine Geology and Geo-ecology - GeoEcoMar

The gravity and magnetic investigation of the Romanian offshore have been carried out during three main phases, the first two by geophysicists working with the former Institute of Geology and Geophysics, today the Geological Institute of Romania and the last one by the geophysical team of the National Institute of Research & Development for Marine Geology and Geoecology – GeoEcoMar.

The first phase of the marine research, carried out between 1969 and 1970, only consisted of magnetic surveys performed with a marine proton magnetometer (Romanescu et al., 1972). It covered most of the Romanian offshore and offered a first structural model of the continental shelf's crystalline basement (Romanescu et al., 1975). The second phase, carried out from 1980 to 1990, consisted of both marine gravity and magnetic surveys. Between 1980 and 1985, marine bottom gravity meters were used to map a maritime sector delimited to north by Gura Portița and to south by Cape Tuzla, covered by waters with depths from 10 m to 40 m. Starting from 1984, marine onboard gravity meters systems were used (Sava et al., 1994) to map most of the Romanian continental shelf, thus being acquired over 24,000 km of marine gravity lines. Terrestrial proton magnetometers, with sensors mounted on the mast of a towed fiberglass boat, have been used between 1980 and 1984 (Sava, 2000) to acquire around 4,500 km of magnetic lines. Starting from 1985, a marine proton magnetometer with towed sensor was used (Sava et al., 1994) to cover almost all the Romanian continental shelf and acquire over 10,000 km of marine magnetic lines.

The third phase of the research, started around 2003 with magnetic mappings within the littoral lagoons and gradually expanded, with the entry into service in 2005 of R/V Mare Nigrum, across the entire Romanian offshore and most of the Bulgarian one. It continues now-a-days and also consists of both marine gravity and magnetic researches (Dimitriu et al., 2016-a), carried out with the old marine onboard gravity meters and respectively with a new generation marine proton and Cesium vapor magnetometers. For the first time, extended sectors of the Romanian littoral shallow waters (magnetometry only) and of the lagoons were covered. Thus, since 2003 have been acquired over 13,400 km of marine gravity lines, all during 2011-2012, within the cross-border-cooperation project MarineGeoHazard and almost 48,000 km of marine magnetic lines, within multiple research projects and services contracts of GeoEcoMar.

The main task of the marine gravity and magnetics investigations carried out within GeoEcoMar R&D institute is the systematic geophysical mapping of the Romanian offshore, at scales ranging from 1:500,000 to 1:50,000 or less, in order to decipher its deep geological structure (e.g. Dimitriu et al., 2004, 2016-a, Dimitriu & Dinu, 2015), to build up 2D/3D simulation models of the subsurface (e.g. Dimitriu et al., 2004, 2008, 2016-b), to deliver information regarding the marine hazards, etc. Other important tasks, assumed by marine magnetics, regards the research and services contracts concluded with offshore operators (e.g. Petromar SA, OMV-Petrom, Prospecțiuni SA, Sterling Energy plc, Paladin Resources plc, Melrose Resources plc, etc.) for the accurate identification of pipelines paths, for finding lost objects and tools (anchors, chains, corers, penetrometers, etc.), for the complex site characterization of locations where drilling rigs, pipelines, oil terminals were to be deployed, etc. During the last years, the marine magnetic research has also approached new domains: the study of submarine cultural heritage and the enhancement of the maritime space security. Thus, exclusively based on marine magnetic information several shipwrecks were discovered (e.g. Dimitriu, 2015, Dimitriu et al., 2018). Marine magnetics brought valuable information regarding the wreckage site of an early Roman (2nd Century AD) wooden shipwreck discovered nearshore Gura Portita (Dimitriu et al., 2018-a) and the presence of numerous UXO targets within the area envisaged for Burgas harbor expansion (Dimitriu et al., 2017). Unknown remains of the former marine mine-fields deployed off Constanța were also highlighted by recent marine magnetic researches (Dimitriu et al., 2018-b).

References:

Dimitriu, R.G., Dinu, C., Sava, C.S., Tambrea, D., 2004, Deep geotectonic controls revealed by geophysical potential data on the Romanian offshore: AAPG European Region Conference with GSA, Prague, Czech Republic, Conference CD-ROM, 6 pp; DOI: 10.13140/RG.2.1.2042.2485

Dimitriu, R.G., Dinu, C., Sava, C.S., 2009, The northwestern Black Sea margin tectonics revealed by potential geophysics and its remote influence on the sedimentary cover structure: Extended Abstracts Volume of the IGCP 521 - INQUA 0501 Fifth Plenary Meeting and Field Trip, Izmir-Çanakkale, Turkey, 22-31 August 2009, 58-59

Dimitriu, R.G., Dinu, C., 2015, Study of marine gravity and magnetic data on the Romanian offshore within an area of interest which includes blocks EX-27 Muridava and EX-28 Est Cobălcescu. The 2¾D modelling of marine gravity and magnetic data: Scientific Research Report, GeoEcoMar for Petroceltic Romania B.V. Amsterdam, Bucharest Branch: 54 pp

Dimitriu, R.G., 2015, Marine magnetometry/gradiometry: an efficient tool for the research of the sea bottom: Conferinta finală a proiectului HERAS "Mostenirea arheologică submarină din partea de vest a Mării Negre", Constanta, Romania, 23.02.2015

Dimitriu, R.G., Oaie, G., Ranguelov, B., Radichev, R., 2016-a, Maps of the gravity and magnetic anomalies for the Western Black Sea continental margin (Romanian-Bulgarian sector): 16th

International Multidisciplinary Scientific GeoConference SGEM2016, Science and Technologies in Geology, Exploration and Mining, Conference Proceedings, ISBN 978-619-7105-57-5 / ISSN 1314-2704, 1, 3, 537-544, DOI: 10.13140/RG.2.1.1401.2405

Dimitriu, R.G., Dinu, C., Munteanu, I., Stanciu, I.M., 2016-b, Potential data interpretation and 2¾D modelling aiming to decipher an elevated structure revealed by 3D seismic on the Romanian offshore: 16th International Multidisciplinary Scientific GeoConference SGEM2016, Science and Technologies in Geology, Exploration and Mining, Conference Proceedings, ISBN 978-619-7105-55-1 / ISSN 1314-2704, 1, 1, 499-510, DOI: 10.13140/RG.2.1.4830.3603

Dimitriu, R.G., Shtirkov, I., Barbu, M.-B., 2017, UXO search off Burgas: A high resolution marine magnetic survey prior to the start of the second phase harbor's expansion: 17th International Multidisciplinary Scientific GeoConference SGEM2017, Conference Proceedings, 17, 14, 537-544, ISSN 1314-2704, DOI: 10.5593/SGEM2017/14/S05.060

Dimitriu, R.G., Nuțu, G., Popa, A., Barbu, M.B., 2018-a, High resolution geophysics off Danube delta's shore line for the evaluation of its cultural heritage load. Case study: the mouth of New Dunavăț paleo-distributary: 18th International Multidisciplinary Scientific GeoConference SGEM2018, Conference Proceedings, 18, 1.1, 855-862, ISSN 1314-2704, ISBN 978-619-7408-35-5

Dimitriu, R.G., Barbu, M.-B., Stanciu, I.M., Roșca, V., 2018-b, Implementation of a geophysical investigation and monitoring tool of the Romanian maritime space - MAR-S; Main results of the marine magnetic researches: MAR-S Workshop, 18th October 2018, Constanta, Romania

Romanescu, D., Roşca, V., Soare, A., 1972, Recherches magnetometriques sur la plate-forme continentale de la Mer Noire a large des cotes roumains: Rev. Roum. Geol. Geophys, Geogr., Ser. Geophys, v. 16, p. 103-107

Romanescu, D., Roşca, V., Soare, A., 1975, Contribution a l'interpretation de la carte magnetique de la plate-forme continentale de la Mer Noire a large des cotes roumaines: Rev. Roum. Geol., Geophys. Geogr., Ser. Geophys. v. 19, p. 55-62

Sava, C.S., Dimitriu, R.G., Sava, P.C., 1994, Contributions of the marine gravity and magnetic survey to the geological knowledge of the Black Sea Romanian shelf: Symposium on the "Petroleum geology and hydrocarbon potential of the Black Sea area", Varna, Bulgaria

Sava C.S., 2000, Aplicarea metodei gravimetrice la cercetarea platoului continental românesc al Mării Negre: Universitatea Bucureşti, Facultatea de Geologie-Geofizică, Teza de Doctorat, 270 pp

Recent hydro-morphological and sedimentological processes on the Danube Delta, St. George and Sulina branches

Laura Tiron Duţu[1], Florin Duţu[1], Mireille Provansal[2], Nicolae Panin[1], Gabriel Ion[1], Adrian Popa[1]

[1] National Institute of Marine Geology and Geo-ecology – GeoEcoMar

[2]UMR 6635, CEREGE-CNRS, Europôle Méditerranéen de l'Arbois, 13545, BP 80, Aix-en-Provence, Cedex 04, France

Large river deltas are complex alluvial systems of outstanding social, ecological, and economical importance. Most of them are deeply influenced by human activity: dam construction and meander cutoff. Moreover, river training operations (such as construction levees and meander cutoff) initiated for navigational and flood defense purposes often lead to dramatic changes in the streamwise profiles. Meander correction affects both the hydraulic and morphodynamical behavior of the modified branches that sedimentation occurs in time, while newly built canals usually experience degradation (Ichim and Radoane, 1986).

Since the 1860s intensive anthropogenic disturbances have affected the channel of the Sulina branch in Danube Delta. The works started later (after 1980s) on St. George branch, the southern distributary of the Danube River. The meander cutoff programme induced different hydrosedimentary impacts on the local distribution of river flow velocities, discharge, and sediment fluxes between the former meanders and the man-made canals (Ichim and Radoane, 1986; Popa, 1997; Panin, 2003, Tiron, 2010).

We presents recent data on the hydrological and sedimentary processes at work along Sulina Channel and St. George branch, as an example to analyse the human impact in the Danube River delta. Bathymetry, flow velocity, bed sediments, suspended-load concentration, and liquid and solid discharge data were acquired throughout several cross sections of both natural channels and artificial canals of the three cutoffs, using acoustic Doppler current profiler (ADCP) technology, in order to investigate the distribution of the flowand sediment and its impact on the hydrosedimentary processes in each channelized reach and adjacent former meander. 3D bathymetrical data (using multibeam technology) were aquired and very fine details of the bed were analysed.

On the Sulina Channel the recent hydro-morphological and sedimentological processes are influences by the presence along the channel of the groins, dikes, and by the dredging activities that produce major modifications on the flow and sediments fluxes to the sea.

On the St. George branch, the main problem is respresented by the cut-off works. Here, the water flow acceleration in the artificial canal enhances incision processes in the artificial canal (gravitationally related sedimentary flow), while the liquid and solid fluxes through the former

meander are greatly reduced, with sediment deposition processes. The former main channel undergoes very visible infilling processes correlated with the decrease in hydraulic energy.

The results offer a more continuous view of the variability in the erosion capacity along natural channels and artificial canals.

References

Ichim, I., Radoane, M., 1986. Efectele barajelor in dinamica reliefului. Abordare geomorfologica.Editura Academiei, Bucuresti (157 pp.).

Panin, N., 2003. The Danube delta. Geomorphology and Holocene evolution: a synthesis. Géomorphologie: Relief, Processus, Environnement 4, 247–262.

Popa, A., 1997. Environment changes in the Danube delta caused by the hydrotechnical works on the St. George branch. Geo-Eco-Marina 2, 135–147.

Tiron, L., 2010. Delta du Danube — Bras de St. George. Mobilité morphologique et dynamique hydro-sédimentaire depuis 150 ans. Geo-Eco-Marina Special Publication 4 (280 pp.).

Gas charged sediments and gas hydrates studies at GeoEcoMar

Gabriel Ion, Florin Duțu, Adrian Popa, Sorin Balan

National Institute of Marine Geology and Geo-ecology – GeoEcoMar

The first major reporting of gas hydrates and gas charged sediments, based on a project in which GeoEcoMar has been involved, is back in 2001, when using data collected in the framework of the French-Romanian bilateral project BLASON, gas charged sediment structures has been reported on the continental platform, slope and a unique five layered cluster of BSRs has been for the first time evidenced on the continetal slope. This reporting has been a trigger for further developments and research programs related to the methane hydrates and gas charged sediments presence in the Black Sea area and more specific in its Romanian part.

Back in 2002 GeoEcoMar started the first national project dealing with the methane hydrate researches in the Black Sea (Romanian part). At that time it was a project won at national level, by competition and financed by the Romanian government (in the framework of the national research program Mener). The project employed existing industrial multichannel reflection seismic data, in order to search for the so called Bottom Simulating Reflectors - BSRs, a seismic horizon worldwide accepted as the best indirect indicator for the potential existence of methane hydrates (in fact it is supposed to be an anomalous surface that separates sediments from above that surface and some free gas below it). At the end of the project, in 2005, two areas of BSRs (one to the SW of the Danube Canyon and the other one to the NE of it) has been mapped; these areas cover about 2754.6 km^2, and based on simple asssumptions regarding the concentration of the metahne hydrates in the sediment pile (taking into account an averaged porosity of these sediments and a reduced degree of occupancy by hydrates of the pores) a volume of $6.945*10^8$ m^3 of pure metahne hydrates has been estimated to be hosted in the above mentioned areas.

Following these researches, another national project has been awarded, these time regarding the stability of the continetal slope in the area of methane hydrates accumulations. The project put in evidence several areas of features that indicates past accumulations of gases in the sediment pile and the fact the slope is in general stable (being in general covered by a drape of recent sediments).

Currently GeoEcoMar is running two projects dealing with the gas charged sediments and methane hydrates: a national core project (dealing with the dissociation of hydrates and methane escape in the water column) and a national project called uBiogas, dealing with the study of the natural production of the biogenic methane and its accumulation in the sediment pile, projects that study the Romanian part of the NW slope of the Black Sea.

Reedbeds. A green solution for waves attenuation tested in the Danube Delta

Maria S. Ionescu[1], Adriana M. Constantinescu[1], Albert M. Scrieciu[1], Adrian Stănică[1], Iris Moeller[2], Ben Evans[2]

[1]National Institute of Marine Geology and Geo-ecology – GeoEcoMar

[2]Cambridge University. School of Geography

Protecting coastal habitats is one of the most pressing challenges for managers and local authorities, all over the world. Increasing sea levels, climate change and associated extreme events, together with population growth in coastal areas make this problem even more pressing.

A more efficient way to manage coastal areas worldwide is now being developed through several projects. An innovative, sustainable and cost-effective coastal management strategy involves including features of natural environments in coastal protection plans. To incorporate this approach into management schemes we need to know more about the exact mechanisms of how different coastal ecosystems attenuate the effects of storm surges and associated phenomena and how we can incorporate this information into assessment methods accessible to all stakeholders.

The role of reedbeds in wave attenuation was already proven effective in previous studies (e.g. the Baltic Sea – Moeller et al., 1996, 2001) and it was tested further in the Danube Delta, within the FP7 FAST project. Instruments to measure wave height, wave energy and water levels were deployed at two sites in Razelm-Sinoe Lagoon System between 2014 and 2016. This study brings new insights into the capacity of reed beds to be used as shore protection for wind-induced waves. Understanding the interaction between vegetation and waves creates a better knowledge of ecological and geomorphological processes in coastal waters, mainly of the power of vegetation against hydro-meteorological risks and its sustainable management.

Black Sea submarine canyon systems. A general overview

Dan C. Jipa, Nicolae Panin, Cornel Pop

National Institute of Marine Geology and Geo-ecology – GeoEcoMar

Submarine canyons are frequent on the Black Sea continental slope. The basin-wide dispersion of the canyons is presented by several authors, which revealed more than one hundred canyons on the Black Sea slope. The submarine canyon investigation was not a priority in the Black Sea basin. Presently there are only 12-14 canyons we have information about. These Black Sea canyons are at quite different scientific investigation levels. Danube Canyon and Deep Sea Fan and Bosporous Canyon are well known. Sakarya Canyon was also investigated, mostly in the upper part. Other canyons are little known, many only by their canyon heads, or as single valley traced on regional bathymetric maps.

Taking advantage of the modern bathymetry maps, the authors purpose was to reconstruct the local, primary submarine valley system, the canyon is a part of it. The multitude of canyon submarine valleys systems reveals the regional/basinal canyon network.

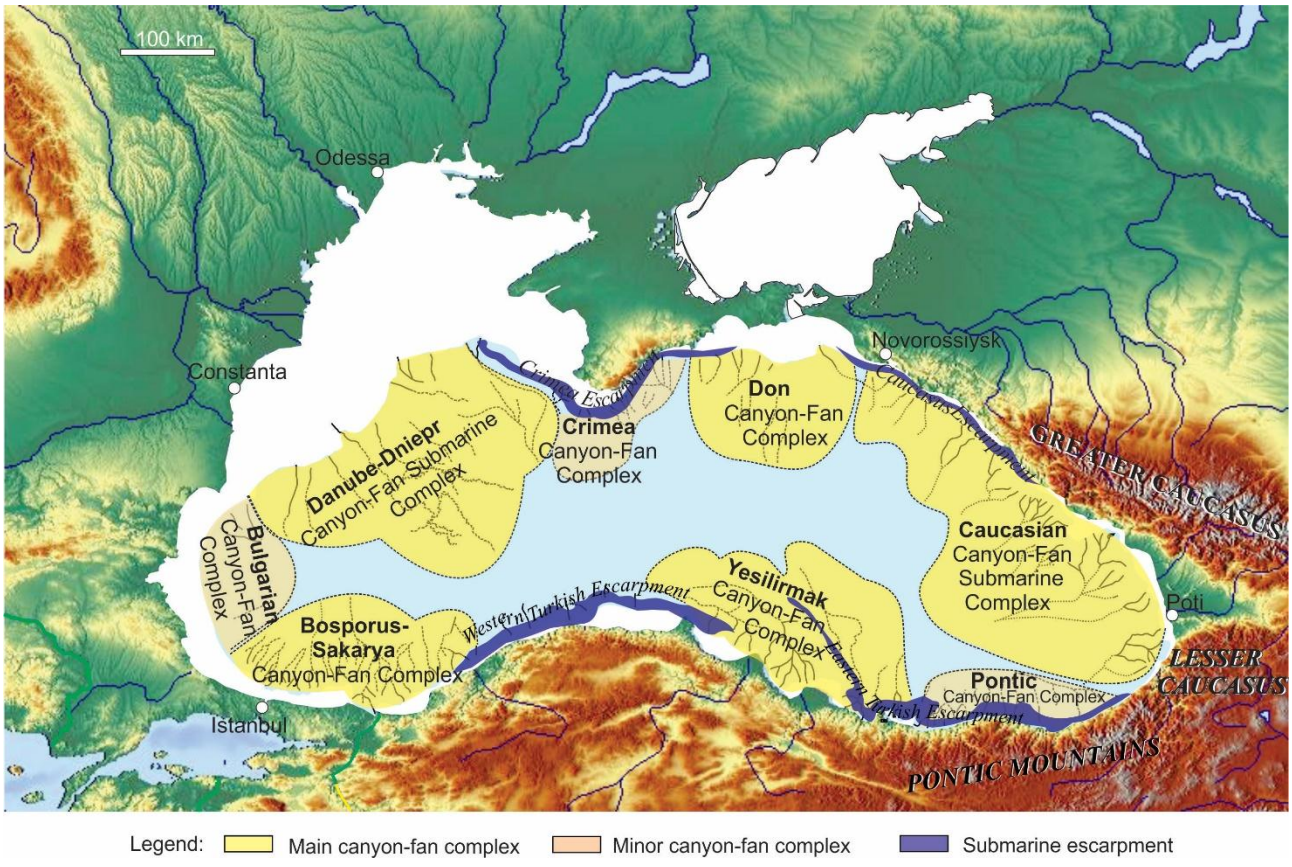

Fig. 1. Black Sea canyon and fan valley network and the main deep sea sediment accumulation areas.

According to the density of the bathymetric lines two morphologic types of submarine valleys were distinguished: narrower, steeper-sided valleys (interpreted as canyons) and wider valleys (interpreted as fan-valleys).

The reconstruction of the Black Sea canyon systems and networks was carried out using High Resolution digital bathymetry maps of the European Marine Observation and Data Network (EMODnet).

Quaternary time scales for the Pontocaspian domain: Interbasinal connectivity and faunal evolution

Wout Krijgsman and collaborators

Department of Earth Sciences, Utrecht University, Netherlands

The Pontocaspian (Black Sea - Caspian Sea) region has a very dynamic history of basin development and biotic evolution. The region is the remnant of a once vast Paratethys Sea. It contains some of the best Eurasian geological records of tectonic, climatic and paleoenvironmental change. The Pliocene-Quaternary co-evolution of the Black Sea-Caspian Sea is dominated by major changes in water (lake and sea) levels resulting in a pulsating system of connected and isolated basins. Understanding the history of the region, including the drivers of lake level and faunal evolution, is hampered by indistinct stratigraphic nomenclature and contradicting time constraints for regional sedimentary successions. In this study we review and update the late Pliocene to Quaternary stratigraphic framework of the Pontocaspian domain, focusing on the Black Sea Basin, Caspian Basin, Marmara Sea and the terrestrial environments surrounding these large, mostly endorheic lake-sea systems.

Today, water supply is mostly controlled by runoff contributions from Eurasian rivers (e.g., Volga, Danube, Don, Dniester and Dnieper) with some additional direct contribution of rain over the lakes. The river runoff is determined by regional climate systems and responds to global climate change. On multi-millennial timescales there has been increased river discharge during warm interglacial periods. Further contributions occurred due to melting of the ice sheets during periods of deglaciation. Furthermore, “extinct” river systems contributed significantly to lakes in the past.

Previous studies suggested that climate change was the dominant driver of Quaternary sea level variations in the Pontocaspian domain, but there are conflicting ideas concerning the relative importance of different potential drivers as well as the mechanisms/routes by which they impacted basin connectivity and sea/lake level. For example, different opinions exist on the importance of particular drivers of lake level change in the Caspian Basin during the last interglacial.

Benthic community structure characterization of the bed-sediment layer composition in-Musura and Sacalin Bay

Selma Menabit[1], Bianca A. Pavel[1], Diana Mînzală[2], Andra Bucșe[1], Naliana Lupașcu[1], Cornel I. Pop[1], Irina Catianis[1]

[1]National Institute of Marine Geology and Geo-ecology – GeoEcoMar
[2]Dunărea de Jos University, Doctoral School of Engineering, Galați, Romania

Key words: Musura Bay, Sacalin Bay, brackish water, benthic fauna

The aim of this study was to inventorize the existing benthic organisms of the Musura and Sacalin Bay, in order to evaluate the habitat status within these areas. Musura and Sacalin Bay belong to the avandelta, part of the Danube Delta Biosphere Reserve (DDBR). The Musura Bay experienced an accelerated tendency of the alluvial phenomenon towards isolation from the Black Sea due to an active process of remodeling the boundaries between the real delta, the marine waters and the allochthonous flow of the Danube (by creating a sand belt in the mouth of the bay). The hydromorphological changes left their mark on the evolution of the ecosystem, at a very relatively accelerated spatio-temporal scale. Thus, there was a gradual transition from the maritime golf stage to a lagoon with freshwater features. Sacalin Island is located on the south of Saint George's branch and village, with a shape and a length that varies in time, having a length of about 22 km. Sacalin Bay is located in the area between the island and the delta, and is characterized by a brackish regime. The study of Sacalin Bay morphology is important for the quality of the aquatic environment (*i.e.,* clean, brackish water habitats), essential for the survival of sturgeons and other endangered species during their juvenile period. A general characterization of the environmental conditions has been carried out, based on 19 samples collected in August 2018. The results of the water quality variables analysis (*i.e.,* water temperature, pH, dissolved oxygen, nutrients, chlorophyll "a", sulphates, cyanide, organochlorine pesticides, silica, oxido-reduction potential, sulphides and hydrogen sulphide, total organic carbon) were included within the limits set by the environmental standards and were fairly consistent from a spatial point of view, in both areas. Instead, other parameters as turbidity and total suspended solids showed values that exceeded the established limits. Salinity showed a variation from 12 ‰ (in 1942) to 0.2 ‰ (at present) for Musura Bay, whereas for Sacalin Bay the salinity was 6.9 ‰ (at present). The results of the sediment geochemistry analyses showed a high spatial variability (ca. 71%) of total mercury concentrations (mg/kg of dry sediment); Cd and Co concentrations were recorded below the detection limit (0.085 mg/kg of dry sediment for both elements). As, Cr, Zn and Pd concentrations from Musura did not exceed the allowed thresholds, except for Ni. Higher concentrations of Cu found in Musura Bay samples exceeded the limits, while in Sacalin only one sample concentration of Cr was far below the quality criteria according to Order 161/2006 (103 mg/kg). The lithological characterization reveals that the majority of the tested bed-sediment samples collected from the investigated

areas can be included in the terrigenous (siliciclastic) rich-sediment type. The faunistic research highlights the presence of 17 taxa belonging to 11 major invertebrate taxonomic groups (Oligochaeta, Polychaeta, Bivalvia, Ostracoda, Amphypoda, Misida, Isopoda, Trichoptera, Chironomida, Heteroptera, Ceratopogonidae) and the presence of 46 taxa belonging to 20 groups (Oligochaeta, Polychaeta, Turbellaria, Hirudinea, Gastropoda, Bivalvia, Ostracoda, Amphipoda, Isopoda, Misida, Cumacea, Decapoda, Trichoptera, Zygoptera, Ephemeroptera, Lepidoptera, Chironomida, Heteroptera, Ceratopogonidae, Chaeboridae) in Sacalin Bay. The average general density of the benthic populations in Musura Bay was 8 times smaller than the one in Sacalin Bay. Most of the identified species within this study seem to be extremely tolerant to temperature and salinity variations.

ACKNOWLEDGEMENTS

The research leading to these results has received funding from the Ministry of Research and Innovation - "Program Nucleu" 13N/2018 – PN 18 16 01 02, as well as Danubius RI, DANS Project.

Integrated assessment of benefits and co-benefits of Nature Based Solutions using System Dynamics Modelling – Lower Danube Case Study

Alessandro Pagano[1], Raffaele Giordano[1], Albert M. Scrieciu[2], Bogdan Alexandrescu[2]

[1] National Research Council - Water Research Institute - Via De Blasio, 5 - 70123 Bari, Italy

[2]National Institute of Marine Geology and Geo-ecology – GeoEcoMar

The increase in the magnitude and frequency of natural disasters is causing growing impacts on citizens, on the built environment and on economic activities worldwide. Specifically in terms of water-related risks (i.e. floods and droughts), the European situation is characterized by an increasing vulnerability, which is exacerbated by several phenomena such as e.g. the increasing urbanization, the land-use change and the social growth.

Water-related risks are traditionally managed through 'gray' infrastructures (e.g. dams, protective barriers, etc.), particularly when the reliability needs are high and the tolerance for failure low, since there are well-established design criteria and information on their technical effectiveness. However, the use of such infrastructure is being increasingly questioned because there are evidences about the possibility that they may threaten people and the environment. Furthermore, they are capital intensive, potentially unsuccessful over long time spans and often responsible for the onset of additional problems, such as the damage or alteration of biophysical systems. There is thus a new focus of Nature Based Solutions (NBS), which are measures "inspired and supported by nature", cost-effective, and capable to simultaneously provide additional environmental, social and economic benefits (i.e. 'co-benefits'). NBS bring together well-established ecosystem-based approaches and concepts, stressing the importance of multiple benefits associated to systemic solutions that combine technical, business, finance, governance, regulatory and social aspects. They are even more effective when coupled with grey or 'soft' (socio-institutional) measures ('hybrid measures').

Nevertheless, additional research is needed to predict the performances, limits and impacts of NBS. A new generation of integrated and multi-dimensional models is needed, capable to rely on the analysis of their effectiveness to deal with water related risks, but going beyond it, exploring social acceptability and specific trade-offs for different configurations and solutions. Indeed, in order to be fully functional and effective, NBSs should be developed by directly involving relevant stakeholders in the decision-making process, starting from the individual risk perception and the analysis of potential ambiguities, the identification of individual goals and objectives, and supporting the process of awareness raising associated to

the quantitative analysis of the implications of such measures, particularly in terms of co-benefits.

Starting from these premises, the activities performed within the H2020 research project NAIAD in the Lower Danube case study are oriented to the development of an integrated model, based on System Dynamics Modeling (SDM) tools, to support participatory approaches aiming at enhancing the introduction of NBS to deal with water related risks. Two study areas are specifically investigated, i.e. the area between Calafat and Rast (flood) and the area between Dabuleni and Corabia (drought and flood). Physical risk assessment tools are being used (Hec-Ras), to identify and map the flooded areas and to analyze the potential effect of NBS on the reduction of risk levels. Quantitative and semi-quantitative indicators are being computed to assess the impact of drought phenomena. These results are integrated, using the results of both individual and participatory activities carried out with relevant stakeholders in a multi-steps process, in a SDM built with Stella Architect®. The model aims at analyzing the multidimensional impacts of NBS, both in terms of reduction of water related risks, and in terms of potential co-benefits (e.g. increase of water availability for agriculture, reduction of issues on navigation). This should facilitate a dialogue aligning potential divergences and promoting the introduction of NBS.

The Benthic Fauna Associations from the Danube River (Study Case: Corabia Downstream, Bechet area, Salcia Downstream and Iron Gate I Downstream)

Bianca A. Pavel[1], Selma Menabit[1], Diana Mînzală[2], Andra Bucșe[1], Naliana Lupașcu[1], Cornel I. Pop[1], Albert M. Scrieciu[1]

[1]National Institute of Marine Geology and Geo-ecology – GeoEcoMar

[2]Dunărea de Jos University, Doctoral School of Engineering, Galați, Romania

Keywords: Lower Danube River, benthic fauna, aquatic ecosystems, diversity, ecological structure indices

The Danube, the most important European river, has always played a major role in the economics of the riparian countries, constituting a good way of navigation, an abundant supply of water, an important basis for fishing and fish farming and in the last decades an inexhaustible hydropower. The study presents the results of qualitative and quantitative analysis of benthic fauna associations from the 4 sectors: Corabia Downstream Km 626 - 631, Bechet Km 674 – 678, Km 820 Salcia Downstream - Km. 824+500 Iasen, Iron Gate Downstream I - Km 936 – 942 from the Lower Danube River. The investigated physico-chemical parameters showed water temperature values ranging from 8-10°C in April and from 23.7°C to 26.6°C in June. The pH values were particularly stable, ranging from 7.81 to 8.31 and corresponding to a very good water quality. The dissolved oxygen registrated values in the range of 8.01-9.89 mg/L, observing a good oxygenation of the water in the mixture layer 0-50 m. The maximum dissolved oxygen value was recorded at 9.89 mg/L measured in the Salcia area. The collected sediments showed concentrations of $CaCO_3$ between 1-10%, indicating the presence of terigene non-carbonated sediments. Only in 12 samples from the Iron Gate I sector, the $CaCO_3$ values were between 10-20% suggesting the presence of poorly terigene carbonated sediments. The results of geochemistry analyzes revealed that Cadmium and cobalt generally showed concentrations below detection limit (0.085 mg/kg wet sediment for both elements), except few stations were Cd was far below to the quality (0.8 mg/kg). Thus, very high concentrations were measured at Corabia Downstream (4,67 mg/kg), Corabia (4.93 mg/kg), Gura Vaii (4.37 mg/kg) and Iron Gate I Downstream (3.74 mg/kg) stations. The sediment samples colected from Iron Gate I Downstream area revealed also quite high concentrations for some hazardous metals (Cr, Ni, Cu and Zn), exceeded the limits (showing a poor chemical status). Thus, Cr showed values between 107 and 150 mg/kg, Cu between 40,61 and 59 mg/kg, Ni between 60.50 and 104 mg/kg and Zn between 189 and 246 mg/kg. Instead, As and Pb showed values ranging from 9.05 mg/kg and 48.52 mg/kg to 20.43 mg/kg and 63.80 mg/kg, respectively.The concentrations of As, Cr, Cu, Zn and Pd measured in the Corabia area were significant lower compared to those determined in Iron Gate I Downstream area, excepting for Ni (terrigen compound), which showed a maximum

of 50.1 mg/kg in the Corabia area (exceeded the permissible limit set in the Order 161/2006, 35 mg/kg). The faunistic researches highlights the presence of 22 taxa belonging to 14 major taxonomic invertebrates groups (Nematoda, Oligochaeta, Polychaeta, Turbellaria, Spongia, Hirudinea, Gastropoda, Bivalvia, Amphipoda, Isopoda, Trichoptera, Lepidoptera, Chironomida, Ceratopogonidae) in April and the presence of 20 taxa belonging to 15 taxonomic groups (Nematoda, Oligochaeta, Polychaeta, Turbellaria, Spongia, Hirudinea, Gastropoda, Bivalvia, Amphypoda, Isopoda, Trichoptera, Coleoptera, Efemeroptera, Chironomida, Ceratopogonidae) in June 2018 in the four analyzed sectors. The average general density of the benthic populations in the four sectors of the Danube in April 2018 was 61,960.2 ex.m-2, respectively 40,233.8 ex.m-2 in June 2018, composed by worms 38%, crustaceans 28%, molluscs 24% and insect larvae 10% in spring, respectively crustaceans 66%, worms 17%, the rest of the percentage belonging to insect larvae and molluscs, in summer. The average general density of the benthic populations in the four sectors is higher in April 2018 (61960.2 ex.m-2) than in July 2018 (40233.8 ex.m-2), as an effect of seasonal changes. Over the spring – autumn, the abundance of benthic organisms decreases progressively.

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Formation and evolution of Danube delta beach ridge plains

Sabin Rotaru[1], Alfred Vespremeanu-Stroe[2], Luminița Preoteasa[2]

[1]National Institute of Marine Geology and Geo-ecology – GeoEcoMar

[2]Bucharest University, Faculty of Geography

Similar to other large deltas, Danube delta displays a wide variety of depositional environments resulted from the complex interaction of factors such as river sediment supply, waves, global sea level rise or local neotectonics. One of the common sedimentary features encountered in Danube delta is the beach ridge plain, formed through the juxtaposition of successive berms on the prograding deltaic coast, with variable morphological expressions depending on the the accretionary mechanisms and the accomodation space.

This study focuses on the formation and evolution of Danube delta beach ridge plains based on age determinations (OSL) of the embedded paleoshorelines, topographic (DGPS) and geophysical surveys (GPR) and stratigraphic interpretations of cores. We establish a detailed chronological framework for all beach ridge plains which highlights the importance of formation timespan and growth rate on the resultant morphology varying from low ridgesets with subparallel beach ridges (progradation rates of 3.5 – 12 m/yr) to high ridgesets where the original configuration was replaced by massive parabolic dunes or transgressive dunefields (progradation rates ≤ 3.5 m/yr). A six-type morphogenetic classification of beach ridge plains is discussed in relation to the various spatial patterns of progradation – from large strandplains developed on the updrift side of asymmetric lobes to the small ones accommodating the prograding sectors of the river mouths spits. Moreover, we identified three types of progradation specific to Danube delta ridges: i) beach face accretion during fair-weather, ii) nearshore bar welding, and iii) berm crest building during storms.

Studies dedicated to large (spatial and temporal) scale coastal behavior are important as they serve as background for interpreting and understanding the present shoreline response at risk under natural and anthropogenic pressures.

Danube and Western Black Sea Basin - in favour of CCUS implementation

Constantin S. Sava, Alexandra C. Dudu, Sorin Anghel

National Institute of Marine Geology and Geo-ecology – GeoEcoMar

Global efforts to reduce CO_2 emissions are needed and made in order to keep global warming below 1.5°C above pre-industrial levels. One of the most promising technologies that could reduce CO_2 emissions from the industry if it is implemented on a large scale is CO_2 capture, utilisation and storage (CCUS).

At the moment, large-scale implementation of CCUS faces the challenge of defining a viable business case which can be achieved through utilisation of captured CO_2 for EOR (Enhanced Oil Recovery) and EGR (Enhanced Gas Recovery) and the establishment of a transport infrastructure. The use of captured CO_2 for EOR (CO_2-EOR) has become a well-sustainable business in the United States having also an impressive pipeline network for CO_2 transportation. In Europe, potential storage operators and petroleum companies failed to see the business case behind CO_2-EOR, already demonstrated in the United States and researchers are struggling to promote CCUS and CO_2 emission reduction through this technology.

At a European level, there were several important research projects dedicated to analysis of transport possibilities for CO_2 and several transport models were designed (JRC, EUROPIPE), including a European network of pipelines and CO_2 hubs. The most cost-efficient model includes the use of a common transport and storage infrastructure for an industrial cluster composed from several CO_2 sources.

Romania is committed to reduce CO_2 emissions and one of the measures mentioned in the energy strategy for decarbonising especially the energy sector is carbon capture and storage (CCS). The research on CCS started in Romania in 2001, since the affiliation of GeoEcoMar to ENeRG, continued with estimation of storage capacity and elaboration of the Feasibility Study for full-chain demonstration project GETICA CCS (currently stalled for lack of financing). The research in the CCS field also lead to evaluation of storage possibilities in Romania, planning of transport routes for GETICA and Oltenia region (on-going activity in ALIGN-CCUS project) and assessment of storage and utilisation options in the western Black Sea Basin.

At the scale of the Southern part of Romania and, why not, for a large part of Europe, promoting the multimodal transport of CO_2 could surpass the difficulties of building pipelines everywhere as well as, for example, those of public acceptance and trans boundary cooperation, apart others. Instead of a unique network of pipelines, multimodal transport of CO_2 means a large usage of specialized ships on the inland waterways, and short pipelines between the emission sources as well as suitable storage locations with the closest harbours, in our case, pairing industrial sources with the closest geological deposits, for transport through pipelines and pairing both the industrial sources and the geological deposits with the closest Danube harbours.

GeoEcoMar is the single Romanian organisation having in the same time high professional experience in the complex geological and geophysical studies on the Danube and the Western Black Sea Basin as well as in the CCUS studies.

Related to the Southern part of Romania, from our previous and present CCUS studies the industrial CO_2 emissions, verified on 2017, and the appropriate geological structures for CO_2 storage as well as oil and gas deposits for EOR and EGR, are well documented.

Risk assessment related to river sediment balance. Integrated methodology developed for Danube river basin

Albert M. Scrieciu, Sabin Rotaru, Mihaela Mureșan, Bianca Pavel

National Institute of Marine Geology and Geo-ecology – GeoEcoMar

Sediments play an important role in maintaining fluvial environments such as channel systems, floodplains, wetlands and estuaries, an equilibrium between erosion and deposition usually occurring along a river course in natural, undisturbed systems. However, human economic activities such as navigation, hydropower, and extractive industry led to significant changes of natural sediments balance and transport along many rivers in Europe. Danube, as the second longest river in Europe, is in high proportion, subject to changes in terms of hydrological and ecological aspects.

This study addresses the issues related to environmental risks associated with the hydromorphological and ecological alteration starting from the Upper Danube sector up to the Lower Sector. We propose a risk assessment methodology in accordance with European legislative instruments such as Water Framework Directive (WFD) or Floods Directive. The WFD hydromorphological elements for quality status assessment include hydrological regime (quantity and dynamics of water flow, connection to groundwater bodies, etc.), river continuity and morphological conditions (river depth and width variation, structure and substrate of the river bed, etc.). The WFD ecological and biological elements are related to macroinvertebrates, fish, macrophytes and phytoplankton.

The proposed analysis is based on the biological and hydromorphological indicators that have already been developed within the WFD as well as within the National Danube Management Plan updated in 2015, in relation to the specific pressures associated to sediment balance and continuity alteration. In order to estimate the potential hydromorphological and ecological risks, we developed a model and a matrix, which can be easily integrated in the risk assessment scheme use by other European countries. Risk estimates are based on categorical rankings that imply a qualitative/quantitative evaluation technique used to rank risks using categories, such as low or negligible, medium or moderate, and very high/high. Ultimately, the risk assessment methodology aims at integrating the hydromorphological and biological methods into one applicable methodology at a basin wide level, highlighting the lines of evidence that support the causality between the two and thus considering the specific response of biological elements to observed or predicted effects of hydromorphological changes.

GeoecoMar activities dedicated to education and promotion of Earth Science

Antoneta Seghedi, Gheorghe Oaie, Tatiana Begun, Vlad Rădulescu, Silviu Rădan

National Institute of Marine Geology and Geo-ecology – GeoEcoMar

Education was an objective of NRDI GeoEcoMar since its foundation, in order to attract young students to research through organizing various scientific meetings, summer schools, coordinating Master and PhD theses, etc. The institute signed memorandums of understanding with the Universities of Bucharest and Iaşi, in order to ensure yearly practice for students on the R/V Mare Nigrum during its Black Sea cruises in various projects.

Fig. 1. Participants to the last summer school organized by EuroGeoEcoCentre in the Danube Delta in September 2005. Photo Alina Pavel.

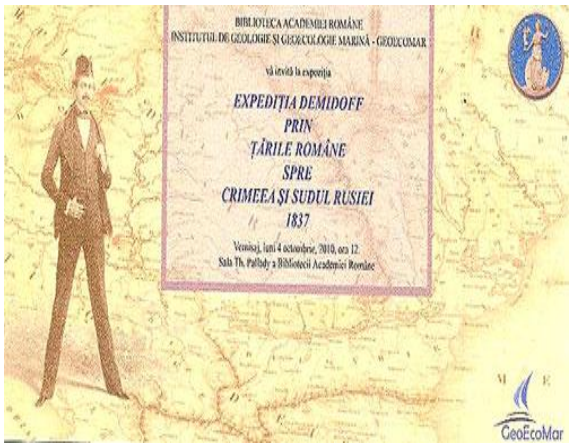

Fig. 2. The poster of exhibition dedicated to the journey of Demidoff exhibition on the Danube, organized in partnership between the Romanian Academy and GeoEcoMar in 2010.

Fig. 3. The field trip in Dobrogea, organized by GeoEcoMar for students from universities in Bucharest and Cluj-Napoca.

Fig. 4. The workshop „Let's make a dinosaur" organized by GeoEcoMar on the Halmyris floating laboratory for pupils from local schools.

A special acchievement of the institute was the statute of European Centre of Excellence for Environmental and Geoecological Studies on River – Delta – Sea Systems in Europe: case study River Danube – its Delta – Black Sea System (EuroGeoEcoCentre). The statute was granted by the European Commission and attracted international recognition by the majority of partners operating in marine research. For several years, EuroGeoEcoCentre organized summer schools in the Danube Delta in order to train students from Romania and European countries in the sedimentology of terrestrial and marine systems (Fig. 1).

Since the establishment in 2013 of the National Center for Monitoring and Warning on Marine Natural Hazards – Black Sea Security System – in Constanţa, which soon became the second objective of national interest managed by GeoecoMar, annual programs of education and internship were run for 20-25 students of the Maritime University in Constanţa.

Starting with 2010, when GeoEcoMar became directly involved in the management of marine protected areas of the Natura 2000 network, every year various hands-on activities were organized for students from secondary and high schools, in order to increase awareness on MPAs, beach pollution, biodiversity. The Institute also started collaborating with other administrators in order to contribute to conservation and promotion of both natural heritage and geological sites. The collaboration with the Hateg Country Dinosaur Geopark resulted in participation to the project Transylvanian Dinosaur Museum, GeoEcoMar contributing significantly to interpretation of paleontological heritage by sponsoring the reconstruction of the most famous dwarf dinosaur in Haţeg Basin, *Balaur bondoc*, as wel as supporting the journey of Magyarosaurus, for which the documentary „A sauropod abroad" was shot by a Canadian team.

A good way to promote earth sciences and increase visibility is through temporary and travelling exhibitions. GeoEcoMar was co-organizer of „The Demidoff expedition through the Romanian Countries to Crimea and southern Russia in 1837" in 2010 (Fig. 2) and „Dobrogea, between land and sea, the imprint of time and man" in 2012, both associated to symposia. Other travelling exhibitions, organized in 2016 and 2017 in a project within the core program of the institute, were meant to promote the most important paleontological heritage of Romania, in collaboration with the Hateg Country Dinosaur Geopark – the only International UNESCO Geopark in Romania: „Brian Cooley – Dinosaur Art" and „The dwarf dinosaurs from Haţeg Country".

A project dedicated to promotion and education in earth sciences was run by GeoEcoMar during 2016-2017, financed by the Ministry of Research and Innovation. The educational program included educational activities for various types of target audience, activities of popularization and promotion of geological and paleontologica sites in two Romanian geoparks, promotion of results accomplished by GeoEcoMar in earth sciences, ecology, marine biology, etc. The educational program elaborated was structured as education in schools, internship for students and geological literacy of the general public. For education in schools ten lesson plans on earth sciences were elaborated, with associated hands-on activities. The internship included a 5 days field trip in Dobrogea to teach undergraduate students about the Ediacaran turbidites of Central Dobrogea and the Variscan ad Cimmerian orogen in North Dobrogea (Fig. 3). The module for the general public included various activities and events: public conferences, geological field trips, the day of open doors at GeoEcoMar, Earth Science Week, the School Differently, various workshops for children (Fig. 4), etc.

Geological education is a necessity in Romania, especially as earth sciences do not have an adequate public presence, while scientific literacy in geology of the people continues to be rather low. Geology is no longer part of the school curricula for almost 20 years, except some basic concepts included in the geography programs. As such, the number of young people interested in a career in earth sciences and choosing to enrol to the faculties of geology is diminishing every year. In order to be successful on long term, education and promotion of earth sciences has to continue, which implies the existence of adequate financial and human resources.

The recent evolution of the Black Sea highlighted by ostracods

Marius Stoica[1], Andrei Briceag[2]

[1]University of Bucharest, Faculty of Geology and Geophysics, Bucharest, Romania

[2]National Institute of Marine Geology and Geo-ecology – GeoEcoMar

In the last decades, numerous research programs targeted the recent evolution of the Black Sea with emphasis on its reaction during and after the last glacial period. During several cruises were collected numerous gravity and piston cores that provided sedimentological and paleontological samples. To complete the obtained information, shallow seismic acquisition, geochemical analyzes and isotopic dating were used.

Ostracods represent excellent proxies, suitable for reconstructing palaeoenvironments. Theirs distribution is highly dependent on water conditions, mainly salinity but also depth, substrate, water chemistry, nutrient availability and temperature. As a main tool, we use ostracods to exemplify how to reconstruct the recent evolution of the Black Sea, from Late Pleistocene – Holocene- Present.

The uppermost 1-1.5 m from the investigated cores contain sediments rich in ostracod shells belonging to species that lives nowadays in the Black Sea. Most of species belong to marine-brackish genera like *Callistocythere*, *Hiltermannicythere*, *Palmoconcha, Loxoconcha, Cytheroma, Cytherois, Sclerochilus, Carinocythereis,* and *Xestoleberis.* The majority of these taxa entered the Black Sea basin after the reconnection with the Mediterranean, around 7500 years ago. In the underlying level, the ostracod fauna differs well from the previously one being represented mainly by fresh to low-brackish Ponto-Caspian taxa of *Candona, Leptocythere, Amnicythere,* and *Loxoconcha* genera. Some species show high affinities with sub-arctic species, suggesting a migration pattern from the NE European lakes through Caspian Sea into the Black Sea during the last glacial period when the connection with the Mediterranean was interrupted due to the sea-level drop.

The transformation of the Black Sea from a fresh water lake (Neoeuxinian Lake) during the last glacial maximum into a saltwater sea is highlighted by the replacement of the fresh-brackish ostracod taxa with a brackish-marine one. The post-glacial warming is also recorded in ostracod faunal composition just before the invasion of Mediterranean Salt water into the Black Sea through the Bosporus Strait.

Holistic approach of the Romanian marine habitats: classification, distribution, biodiversity and quality assessment

Adrian Teacă, Tatiana Begun, Mihaela Mureşan, Adrian Popa

National Institute of Marine Geology and Geo-ecology – GeoEcoMar

Marine habitats play an important role in some of the key ecosystem processes (i.e., primary production, food webs, recycling, etc.), but they are subject to many human pressures which put in risk their functionality (Claudet & Fraschetti, 2010). The paper deals with the modern approach of marine habitats within the context of European policies, such as those relying on the Marine Strategy Framework Directive, The Habitat Directive and EUNIS habitats classification, and the emergent Blue Growth Economy.

In the first place, the principles that stood at the basis of creation of broad-scale benthic habitats map of the Black Sea within the EuSeaMap project will be presented. These will include a short exposing of the methodology (Populus et al, 2017) that helped at delineation of biozones as being shared commonly amongst European seas: infralittoral, circalittoral, offshore circalittoral, bathyal and abyssal. The extent of each biological zone is generally driven by a specific environmental variable that is recognized as having overarching influence on the distribution of the habitats contained within the biological zone. At the Black Sea, the substrate, temperature, density and break of the slope were identified as key variables for the classification of the Black Sea region into biological zones. In the Danube's plume area, the usual identification of the infralittoral/circalittoral boundary based on the estimated percentage of light reaching the sea bottom did not work as appropriately due to combined fine sediment and fresh water apposition interfering with the standard substrate and benthic zonation pattern observed in coastal areas. Delineation of broadscale habitats embedded into the biological zones is the result of the spatial combination of biological zones and benthic communities' distribution. For validation of most habitats, the biological point data of presence of engineering species that were retrieved from the GeoEcoMar and EurOBIS database have been used. In total, 32 broad scale habitats have been agreed for the Romanian Black Sea, of which 19 coastal and 12 habitats on the shelf, respectively.

The progress made in the last years by GeoEcoMar within the Core Program towards improving the mapping of benthic and pelagic habitats is presented.

By helping of a case study, we will exemplify the purpose of habitat mapping and ecological quality assessment of economic impacted circalittoral benthic habitats. The study aimed to assess the magnitude of impact and the post-dredging evolution of the circalittoral benthic habitats and of their populations. The physical disturbance of habitats was investigated by side scan sonar and multibeam bathymetry scanning, which revealed an extent of 2.7 km^2 of the sand extracting area and 33.6 km^2 of the trawled one, totalizing more than 70% of the study area. Based on 23 and 6 samples of macrozoobenthos and meiobenthos, respectively collected during the survey conducted in 2018 and comparing the present results with data collected in 2016, three months after dredging events, the changes in benthic community in terms of diversity and abundance as well as of functional groups dominance were detected.

Increasing efforts on habitats mapping is essential for resources management and spatial planning, therefore the gaps related to spatial covering and measures for habitats and species protection and efficient exploitation should be a priority for researchers and policy-makers.

Bibliography

Claudet, Joachim & Fraschetti, Simonetta, (2010). Human-driven impacts on marine habitats: A regional meta-analysis in the Mediterranean Sea. Biological Conservation. 143. 2195-2206. 10.1016/j.biocon.2010.06.004.

Populus J., Vasquez M., Albrecht J., Manca E., Agnesi S., Al Hamdani Z., Andersen J., Annunziatellis A., Bekkby T., Bruschi A., Doncheva V.,Drakopoulou V., Duncan G., Inghilesi R., Kyriakidou C., Lalli F., Lillis H., Mo G., Muresan M.,Salomidi M., Sakellariou D., Simboura M., Teaca A., Tezcan D., Todorova V. and Tunesi L., (2017). EUSeaMap, a European broad-scale seabed habitat map. 174p.

Inter-annual variability of the water column hydro-chemical structure in the Western Black Sea (Romanian shelf waters)

Dan Vasiliu, Sorin Balan, Dan Secrieru, Naliana Lupaşcu, Andra Bucşe

National Institute of Marine Geology and Geo-ecology – GeoEcoMar

The paper relies on the CTD data collected onboard R/V *Mare Nigrum* (GeoEcoMar) during the period 2010 – 2018. Yearly cruises were carried out within the framework of the Romanian Research Program, either in spring summer (May 2010, April 2011, March 2012, May 2013, and May 2014) or summer (August 2015, June 2016, June 2017, and August 2018) covering the Black Sea Romanian shelf waters. A total of 8 stations (bottom depth within 80 – 200 m) distributed along two sampling transects (Sf. Gheorghe – SE, and Mangalia – E) were considered for the present paper. Additional CTD data collected from the Bulgarian shelf waters in 2017 cruise (May) were also analysed and discussed.

The aim of the work is to analyse/present the temporal variation of the main physical-chemical seawater parameters (temperature, salinity, Sig T, DO, fluorescence) in order to highlight the changes observed within the water column in the last decade.

The vertical structure of the water column is strongly influenced by the Danube River discharges and the meteorological conditions. A weak seasonal thermocline is observed starting with the early spring and becomes more pronounced in summer. A very shallow upper limit of thermocline (3 – 5 m) can be observed in the periods with larger Danube discharges (salinity within 16 – 17 PSU) either in spring or summer. Salinities above 18 PSU lead to deepening of the upper boundary of thermocline up to 20 m (summer) – 35 m (spring). Colder surface layers (April 2012) led to an inverse thermocline at depths coinciding with the upper limit of pycnocline. Not all periods analysed showed a Cold Intermediate Layer (CIL) as it is classically defined.

Dissolved Oxygen (DO) concentrations show a quite homogeneous distribution within the upper column. Bellow the homogeneous layer, a DO maximum (concentrations within 280 – 380 µMol) can be observed at depths between 15 and 30 m, more pronounced in the warm season and, generally, followed by a sharp decrease (oxycline) up to 20 µMol - the upper limit of suboxic layer.

Fluorescence profiles show a maximum at depths of 20 – 45 m, shallower in spring (20 – 35 m). Sometimes, mainly due to the Danube influence, a second shallower and less strong maximum of fluorescence can be observed at depths of 15 – 25 m, generally coinciding with DO maximum.

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