**PN23300201 - Applied research in recent deltaic sedimentary structures to highlight/parameterize the accumulation of marine mineral/energy resources**

**Phase 1: Documentation and synthesis of existing information, preparing the research campaign at sea (deadline: 10 April 2023)**

As the title of the execution phase indicates, during this phase, all the available existing information containing important information for the preparation of the research campaign was inventoried. The inventory was followed by the synthesis that contains both written and graphic information, especially the sections and the geological maps. The identified publications were organized into a bibliographic database containing all the necessary information to be used in the subsequent execution phases of the project. The data already existing in GeoEcoMar archives were also inventoried and structured, being important data for defining the sea research works that were scheduled to be executed in the second phase of project implementation. The important information resulting from the review and synthesis of the publications of interest was structured in a spatial database (GIS – Geographic Information System).

Information was identified on the geological and paleo-climatic phenomena that generated the formation of deltas. One of the important elements is the level variation of the Black Sea during the Quaternary, a phenomenon that occurred several times during the geological period considered. These level variations induced an important dynamics of sediment transport, deposition and erosion. During the time when the current shelf area rose above sea level, a network of rivers existed at this morphological formation level, rivers that, in certain favourable circumstances, had led to the formation of deltaic sedimentary bodies. A first documented information refers to the variations of the Black Sea level during the Quaternary.

Another piece of information that was searched, synthesized and translated into the project database in the form of GIS objects was regarding the existence in the NW part of the Black Sea of ​​some geomorphological elements and sedimentary structures that indicate the existence of a paleo-hydrographic network at the level of the current shelf area. These were paleo-valleys, submarine terraces and even deltaic sedimentary bodies. From "Paleogeography of the Pontic Lowland and northwestern Black Sea shelf for the past 25 k.y.” (Larchenkov E., Kadurin S., The Geological Society of America Special Paper 473, 2011) - fossil coastal areas, deltaic sedimentary bodies had been identified, elements that had been digitised in GIS format and included in the project (see the figure below). Based on this information, the research works at sea were designed, as well the works that were planned to be executed in the second phase of project implementation.

During the execution of phase 1, the equipment to be used in the next research phase was prepared and revised. It was also at this stage that the market was prospected and it was

initiated the purchase of a 12-channel seismic streamer, in order to improve the quality of seismic very high-resolution data, an equipment to be used in this project.

AICI AM NEVOIE DE FIGURA 2, PE CARE VĂ ROG SĂ MI-O TRIMITEȚI PRIN E-MAIL.

Map as GIS objects, numbered and stored in the project database.

Geophysical research and marine geology to identify the palaeo-hydrographic network on the shelf.

Phase 1 deadline: August 10, 2023

**Phase 2**

During phase 2, between July 27 and August 3, 2023, on board of the oceanographic research vessel Mare Nigrum, complex research was carried out at sea, the expedition having the unique indicator MN245.

Researchers (geologists and geophysicists) from GeoEcoMar participated in the expedition. In order to avoid any collision with the floating mines, present in the water as a result of the war between Russia and Ukraine, the activities took place only during the day, the sea being continuously scanned with binoculars from the command area by the sailing personnel. Typically, the research activity would have been carried out 24h/24. Working only during daytime resulted in a considerable decrease in the investigated area.

Due to the presence of military vessels, work was avoided in the northern part of the Romanian area at the Black Sea. Area investigated during the MN245 expedition is given by the polygon with a perimeter of 388.68 km, area of 9397.7 km2, delimited by points with the following decimal geographic coordinates: 28.9460200000E, 43.8147427778N, 30.1179311111111E, 44.7446279868N.

The program consisted of collecting gravity cores (7 cores, of which 6 with recovery of

sedimentary material) and performing in situ measurements with fixed or mobile geophysical equipment installed on the Mare Nigrum research vessel: multibeam echo sounding measurements with the equipment ELAC and Norbit, EdgeTech 3200X sediment sounder, SB-216D towed transducer and SIG sparker single channel (very high resolution seismic). All these activities made intensive use of the equipment (on board the ship Mare Nigrum) for launching and retrieving sampling devices (gravity corer 6m long), towed transducer SB216D, reverse spark (seismic energy source), single-channel seismic streamer (seismic receivers). The satellite positioning and communication equipment of the Mare Nigrum was also intensively used. The permanent staff on board the research vessel Mare Nigrum had directly participated in all related research activities throughout the MN245 expedition.

AICI AM NEVOIE DE FIGURA 3, PE CARE VĂ ROG SĂ MI-O TRIMITEȚI PRIN E-MAIL.

Research work at sea carried out in project execution phase 2.

With yellow are the seismo-acoustic and bathymetry profiles (chirp sub-bokom profiling, seismic of very high resolution and multi-beam echo sounding); the red dots indicate the locations where the gravity cores were harvested. During this phase, the acquisition of very high resolution multichannel seismic equipment was completed, equipment to be delivered in December 2023 – January 2024.

**Phase 3: Processing of the information acquired in F2, production of digital GIS objects and GIS Atlas (deadline: December 7, 2023)**

During this phase of the execution, the multibeam bathymetry data, the data from the sediment sounder (chirp sub-bokom profiling), the data resulted from very high resolution seismic (sparker) were processed and the samples from the gravity cores were

analysed. They were given for analysis at the Beta Analytic Laboratories in USA (for AMS absolute dating and isotopic analysis at 13C and 18O). The samples were also analysed using the XRF and granulometry method in GeoEcoMar’s laboratories at the Constanța branch.

Following the information processing, very high-resolution seismic sections were obtained, emphasising the internal structure of the sedimentary deposits. Thus, it was possible to identify the seismic elements and facies characteristic of river and deltaic deposits.

In one of the harvested cores, the visual, paleontological and absolute dating analyses showed the existence of a lacustrine, deltaic environment (having reed elements) from a former coastal area.

Below are presented two very high-resolution seismic sections (the first of the chirp subbokom profiler type and the second of the sparker type). On the first seismic section, 3 zones were interpreted as having shallow paleo-valleys buried under recent sediments (1-2.5 m thick). On the sparker type sections, two levels of fluvial sedimentation were interpreted, the deeper one being of deltaic fluvial type. The shallower level of fluvial sedimentation is buried under newer sediments at a depth of approx. 14-16 ms twt (9p double travel), at approx. 9v 12-13 m below sediment water interface. The fluvial-deltaic sedimentation horizon lies below a sediment stack that is thick approx. 50ms twt, i.e. approximately 9v 40-42 m, depending on the nature of the covering sediments and their degree of consolidation.

All this newly discovered information, resulting of the research in 2023, was processed and transformed into GIS objects and atlases of very high-resolution seismic sections, as requested by the research program.

AICI AM NEVOIE SĂ ÎMI TRIMITEȚI IMAGINEA

Shallow fluvial sediments (paleo-valleys) identified on sediment sounder data

AICI AM NEVOIE SĂ ÎMI TRIMITEȚI IMAGINEA

Fluvial (paleo-valley) and fluvial-deltaic sediments identified on very high seismic data

resolution (sparker)

During the 3rd phase of the project, a series of software packages for GIS, image processing and graphic representations were purchased. Software maintenance services for all the software packages used to purchase and process the seismo-acoustic and multi-beam bathymetry data were also purchased.

As the presented images very suggestively indicate, all the project objectives programmed for year 2023 were fulfilled.