

ASSESSMENT OF THE SEDIMENTARY SYSTEM OF THE BLACK SEA SINCE THE LAST GLACIAL MAXIMUM

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Abstract

ASSEMBLAGE was an integrated pan-European study of the northwestern Black Sea sedimentary system from the continental shelf to the deep sea. The Black Sea being a unique feature characterised by the only particularly wide shelf in the northwestern sector is the drainage basin of some major European rivers. The Black Sea is also characterised by high sedimentation rates presenting favourable conditions for paleoclimatic studies. The project itself has increased the knowledge of the Southern European Ocean Margin and facilitate access to and use of the Black Sea seafloor and exploitation and exploration of its resources, and preservation of its environment. This was achieved through the examination of existing and collected geomorphologic, geophysical, stratigraphic, sedimentological data permitting progress in deciphering the past climatic and environmental changes of the Black Sea.

Keywords : Black Sea, Sedimentation, Sea Level, Stratigraphy.

ASSEMBLAGE was a European collaborative project focused on the assessment of the North-western Black Sea sedimentary systems from the continental shelf and slope down to the deep-sea zone. The Black Sea is one of the largest marginal seas¹ and one of the largest receiving basins for important European rivers (Danube, Dniepr, Dniestr). ASSEMBLAGE project proposes a preliminary Quaternary stratigraphy for this region.

ASSEMBLAGE project has realised a complex marine research programme in the Black Sea using modern scientific equipment and technology and high expertise by unifying the efforts of scientists from Western Europe and Central-Eastern Europe. As the Black Sea is characterised by high sedimentation rate, this water body presents favourable conditions for paleoclimatic studies, in particular its preferential location being in the immediate vicinity of the ice-cap during the last Glacial period.

ASSEMBLAGE marine research programme objectives were to contribute to have a complete sedimentary record of the past climatic changes over least 20,000 yr in this region and to compare it to the Global record. This has been achieved as an integrated approach of the Black Sea sedimentary system through the examination, the processing and the interpretation of first existing data and secondly of geomorphologic, geophysical, stratigraphic, sedimentological, paleomagnetic and geochemical data acquired during the ASSEMBLAGE project.

aims to advance at the optimum achievable level the assessment of the Black Sea sedimentary system. This has been done through integrated studies on the sedimentary processes and sequences since the last Quaternary period of the Southern European Ocean Margins. The Black Sea represented a unique laboratory in the world and the project was therefore a case study for a better understanding of sedimentary processes in semi-enclosed anoxic basins. The project results now form a basis for extrapolation to other sedimentary systems as well as other closed basin in Europe and elsewhere in the world.

The specific scientific ASSEMBLAGE project outcomes realised are the following:

(1) geomorphologic and stratigraphic studies from the shelf to the deep sea. ASSEMBLAGE project has greatly contributed to the study of the thickness distribution and the analysis of the internal geometry of important depocentres dated from the last 20,000 years of shelf deposits. This geomorphologic studies allowed to determine ages and extension of the connected Danube-Dniepr/Dniestr deep-sea fans. This was correlated to the study of the hydrates potential of this region. To achieve these results ASSEMBLAGE project has used seafloor surveying systems (multi-beam, high-resolution seismic such as CHIRP-sonar profilers equipment). The 1-m resolution of swath mapping sonars combined with very-high-resolution seismic profiles enabled to recognise relict shorefaces formed by successive water level fluctuation, deep-sea fan extension and seeps localisation;

(2) during ASSEMBLAGE first cruise carried out onboard the RV "Marion

Dufresne", a series of long cores were retrieved from the North-western shelf and the deep-sea fans of that cover the Late Pleistocene lacustrine phase and the Holocene marine phase of the Black Sea. Stable isotopes, pollens, molluscs, foraminifers, diatoms, and clay mineralogy of these cores were analysed and the history of climate change at a cm core-resolution was deduced for some specific chosen cores using precise proxies. In hydrates recognised areas, combination of microbiological studies were also carried out with the tools of molecular biology and organic geochemistry;

(3) modelling of the paleo-evolution of the Black Sea level during the Lateglacial-Holocene transition was approached and new estimates for that period based on the analysis of water budget were also provided. Hydrological conditions in the Black Sea catchment area were reconstructed using water balance equation, available data, and constraints based on simple theory relating the runoff ratio with climatic characteristics. In order to estimate the impact of the aridity of climate two alternative scenarios were considered: (3.1) climate change under constant in time gradient in precipitation and evaporation over land and sea, and (3.2) climate change accounting for changes in the horizontal distribution of precipitation and evaporation. Hydrological data were compiled from available present-day data and paleo-observations. A number of sensitivity experiments were carried out revealing that the hydrological conditions in the Black Sea watershed should have evolved towards a very arid climate (similar to the present-day climate in the Caspian Sea area) in order to initiate a drop of sea level of -100 m below the sill depth of the Bosphorus Straits, as speculated in some recent research. Estimates of sea level changes reveal a qualitative agreement with the coast-line evolution inferred from paleo-observations;

(4) building out a comprehensive database and a GIS for the sedimentary systems of the North-western Black Sea as a support of any interpretation and modelling of such sedimentary systems for in-land sea basins. The database and the GIS offer a scientific base for scientists and decision-makers in taking decisions concerning the Black Sea environment and especially the coastal sea and coastal zone protection and rehabilitation and by;

(5) All these information are easily accessible through ASSEMBLAGE web site (<http://www.ifremer.fr/assembleage>) for informing the scientific world and the mass media about the work carried out in the frame of the project as well as for demonstrating the main scientific results obtained.

Reference

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