

## Monitoring of the marine environment state of the northwestern part of the Black Sea

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### SUMMARY

The report contains the results of oceanographic research on the Ukrainian shelf in the northwestern part of the Black Sea carried out by scientists and specialists of the State Institution "Scientific Hydrophysical Centre of the National Academy of Sciences of Ukraine". During the research it was accomplished the hydroacoustic survey of the seafloor with a total area of 70 sq. km. There were obtained a significant amount of hydrophysical data required for studying modern hazardous geological processes and redistribution of bottom sediments within the explored water area. These data are necessary for ensuring the possibility of monitoring of the marine environment state, in particular, in the interests of navigational and hydrographic support of navigation. As a result, a number of natural and artificial objects were identified. Also, the spatial distribution of micro- and mesoforms of the bottom relief and the structure of the upper part of bottom sediments were determined as well as their lithological classification was conducted. The obtained hydrophysical data were sorted and transferred to the Oceanographic Data Bank of the National Academy of Sciences of Ukraine.



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## Introduction

Aiming to study the marine environment state of the Ukrainian shelf in the northwestern part of the Black Sea, integrated research cruise "Black Sea-2018" (hereinafter – "Black Sea-2018") was carried out in October 2018 as one of seven marine and river cruises planned in 2018-2019 (Shchypytsov, 2019).

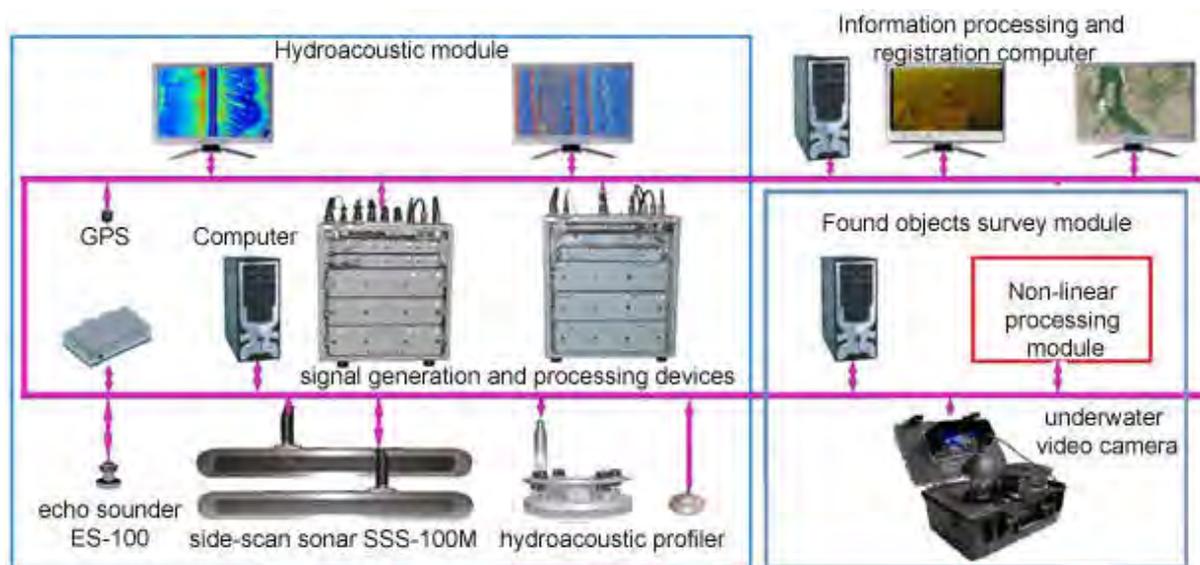
The cruise was conducted with the use of the large hydrographic boat *A. Solodunov* of the State Hydrographic Service of Ukraine and the marine hydroacoustic complex developed by the State Institution "Scientific Hydrophysical Centre of the National Academy of Sciences of Ukraine".

The cruise research in specific areas of the mentioned water area was due to the need to obtain relevant hydrophysical data on the state of the marine environment, seafloor topography and navigational hazards (including silted and small-sized sunken objects).

The route of the cruise "Black Sea-2018" was planned and developed using the archival information of the Oceanographic Data Bank of the National Academy of Sciences of Ukraine. The empirical hydrophysical data obtained during the cruise were added to the mentioned data bank.

## Method and/or Theory

The method of hydroacoustic research was applied using developed by the State Institution "Scientific Hydrophysical Centre of the National Academy of Sciences of Ukraine" (Fig. 1) vessel's hydroacoustic complex (Gonchar, 2011) as well as author's methods. The complex includes: domestic side-scan sonars (SSS-50 and SSS-100M for different depths of survey), ES-100 echo sounder, hydroacoustic profiler, GPS receiver, etc.



**Figure 1** The structure of the hydroacoustic complex

In order to collect, process and storage of hydroacoustic data there was developed software allowing to build field survey sheets of explored water areas with automatic application of a tack scheme (Gonchar, 2012) as well as sonar information linked to coordinates and bathymetric maps. Taking into account the event-oriented information model of the hydroacoustic complex application, software algorithms developed by the State Institution "Scientific Hydrophysical Centre of the National Academy of Sciences of Ukraine" were used to generalize and process data in pseudo-real time. All

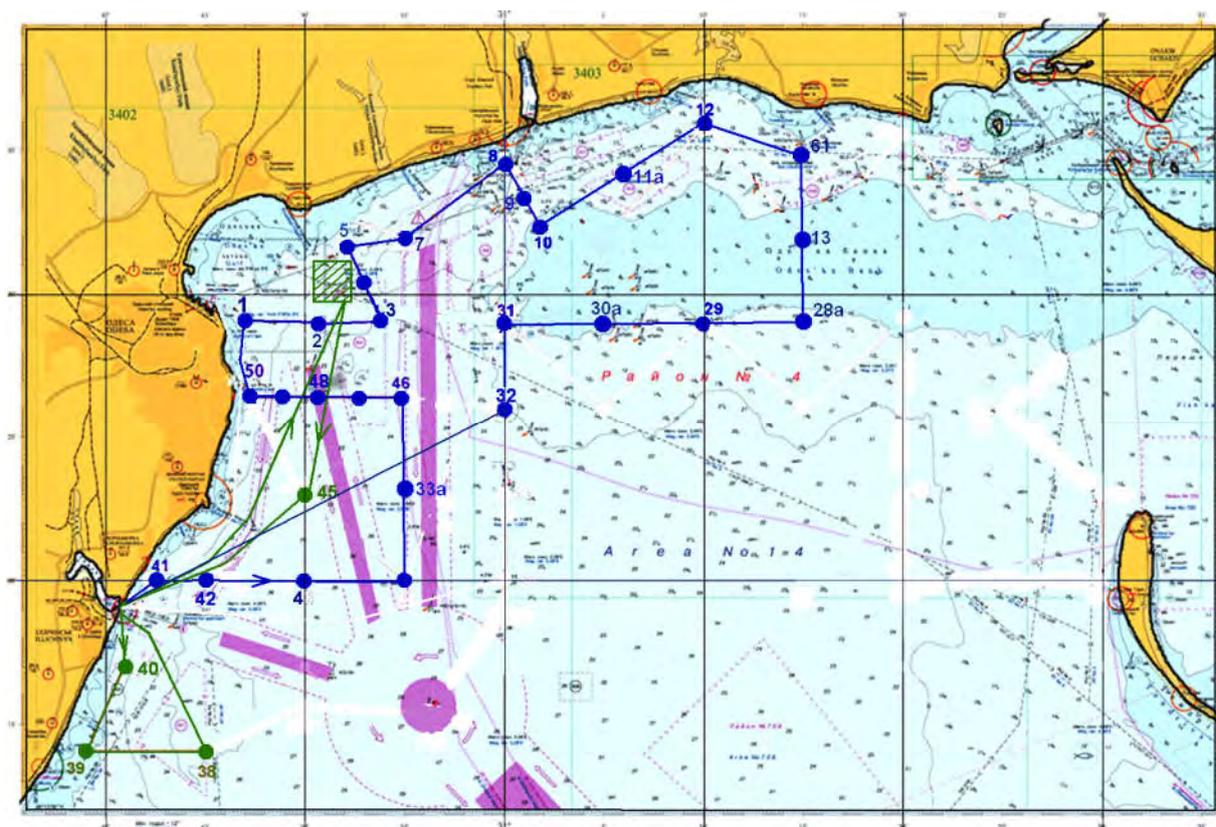


that allowed to get the final product of the water area survey – high detailed echograms. The software consists of a real-time program for receiving and processing information and a pseudo real-time program, ensuring additional and final data processing.

## Results

Cruise works were carried out during vessel's pass and at 50 oceanographic stations (Fig. 2). The total length of the "Black Sea-2018" cruise route (Chernomorsk - Yuzhny - Chernomorsk) was 131 nautical miles (243 km).

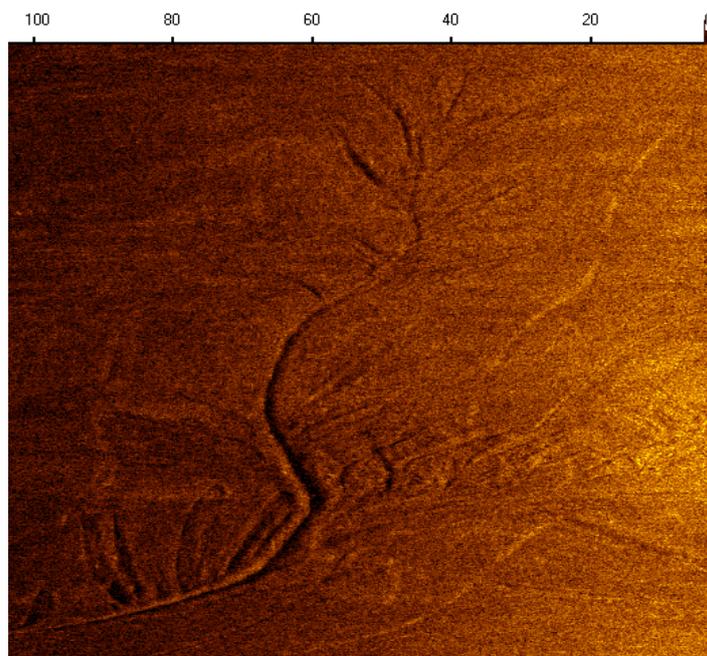
Hydroacoustic methods were used to study the seafloor topography and bottom marine, estuarine (liman) and estuarine-marine sediments of the Quaternary Chernomorian (Black Sea) Horizon (m,ImHčm) as well as technogenic formations in the Odessa Bay water area (Fig. 2).



**Figure 2** Cartographic scheme of the area (Odessa Bay) of the cruise research in the northwestern part of the Black Sea

In Fig. 3 is shown a hydroacoustic image of the Paleo-Dnieper arm valley on the Ukrainian shelf in the northwestern part of the Black Sea.





**Figure 3** Hydroacoustic image of the Paleo-Dnieper arm valley on the Ukrainian shelf in the northwestern part of the Black Sea

The hydroacoustic method of marine environment state studying within the explored water areas of the northwestern part of the Black Sea as well as applied research methodologies allowed to obtain the following results:

- completion of the areal hydroacoustic survey of the seafloor with a total area of 70 sq. km;
- identification of more than a hundred objects of natural and artificial origin, some of which considered as a potential hazard for navigation;
- determination of the coordinates and size of found objects;
- determination of the spatial distribution of micro- and mesoforms of the bottom relief and the structure of the upper part of bottom sediments (the Holocene);
- obtaining the information concerning the state of bottom sediments of the explored water area as well as the structure of the upper part of sediments with a thickness of 2-5 m in density (by Smith, 1974);
- carrying out the lithological classification of the upper layer of bottom sediments. It was discovered that the sediments were homogeneous and only locally, in some separate places, the acoustic signal recorded the structure of layers, significantly differing in petrophysical properties;
- carrying out the new methods approbation of conducting hydroacoustic research and software and technological means.

Separately, it should be mentioned a side archaeological result that consisted in founding of silted wrecks of an aircraft at a sea depth of more than 20 meters.

### Conclusions

The research carried out within the framework of the "Black Sea-2018" cruise allowed to obtain relevant hydrophysical data necessary to study modern hazardous geological processes caused by a redistribution, transportation and accumulation of bottom sedimentary material.

The navigational hazards, including silted and small-sized ones, were explored and identified.



The empirical hydrophysical data were collected during the cruise in order to gain practical experience and further theoretical generalizations in the field of oceanography.

The relevant hydrophysical data were entered into the Oceanographic Data Bank of the National Academy of Sciences of Ukraine that ensured its usage in the interests of the marine environment monitoring and further research.

Detailed information on the bottom relief and morphometric characteristics of the Ukrainian shelf in the northwestern part of the Black Sea is of significant interest for solving applied problems in the fields of navigation, hydraulic engineering, mining, etc., as well as for research in the field of oceanography (in particular, geophysics, marine geology, hydrology, etc.).

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