
INFORMATION

Geological–Geophysical and Oceanographic Studies of the Eastern Part of the Sea of Okhotsk during Cruise 92 of the R/V *Akademik M.A. Lavrentiev*

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Abstract—The paper presents brief results of integrated studies of the northern part of the Sea of Okhotsk close to of the Kuril arc, obtained on cruise 92 of the R/V *Akademik M.A. Lavrentiev* in April–May 2021. The relief was refined and the distribution of geophysical and gas-geochemical fields was obtained. Volcanic edifices hidden in the sedimentary layer were discovered. A large array of data was obtained on the distribution of temperature and salinity of surface waters, as well as the concentrations of methane, carbon dioxide, and atomic mercury in the near-water atmosphere along the route of the vessel.

Keywords: gravimetry, magnetometry, hydrocarbons, gas geochemistry, microbiology

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A comprehensive expedition organized by the Il'ichev Pacific Oceanological Institute (POI FEB RAS) according to the plan of marine expeditionary research took place from April 17 to May 26, 2021, on the R/V *Akademik M.A. Lavrentiev* (cruise 92). In addition to researchers from the POI FEB RAS, the expedition was attended by researchers from the Shirshov Institute of Oceanology RAS and Skryabin Institute of Biochemistry and Physiology of Microorganisms RAS, as well as two students (postgraduate and undergraduate) of Far Eastern Federal University.

The main objectives of the expedition were to study the tectonics and block structure of the Earth's crust, as well as to search for methane emanations and study the distribution patterns of anomalous gas fields, the phylogenetic and functional structure of the microbiome, and the activity of geo- and biochemical processes in sediments and water column of the Kuril Basin.

The bulk of expeditionary research was concentrated in the survey area in the eastern Sea of Okhotsk near Paramushir Island. Research profiles were through the Kuril Basin and parallel to the Kuril Ridge (Fig. 1).

Gravimetric and magnetometric studies, acoustic profiling of the water column, study of the bottom topography, temperature and salinity records in the

surface water layer, as well as atmospheric measurements of the content of methane, CO₂ and mercury in the atmospheric surface layer were carried out along the entire ship route. Geological testing of bottom sediments sampled with seabed and box corers, hydrological studies with an autonomous probe, gas extraction from cores of bottom sediments and water columns, on-board gas chromatographic analysis, mineralogical and microbiological studies were carried out at the stations.

Despite the lack of an echo sounder, the expedition managed to discover the area of gas flares by hydro-acoustic means. As a result, data on the structure of gas flares were obtained and numerous near-bottom acoustic inhomogeneities of unclear origin were recorded. Data on sound scattering in the upper layer of the sea, due to small-scale inhomogeneities (plankton, turbulent layers, bubbles) were obtained.

Geophysical profiling supplemented the previously obtained data of complex geological and geophysical expeditions of the Pacific Ocean Institute of the Far Eastern Branch of the Russian Academy of Sciences. Maps of the gravity and magnetic fields allowing a new assessment of the block structure of the Earth's crust in the study water area were constructed. Hidden volcanic structures were found in the study water area,

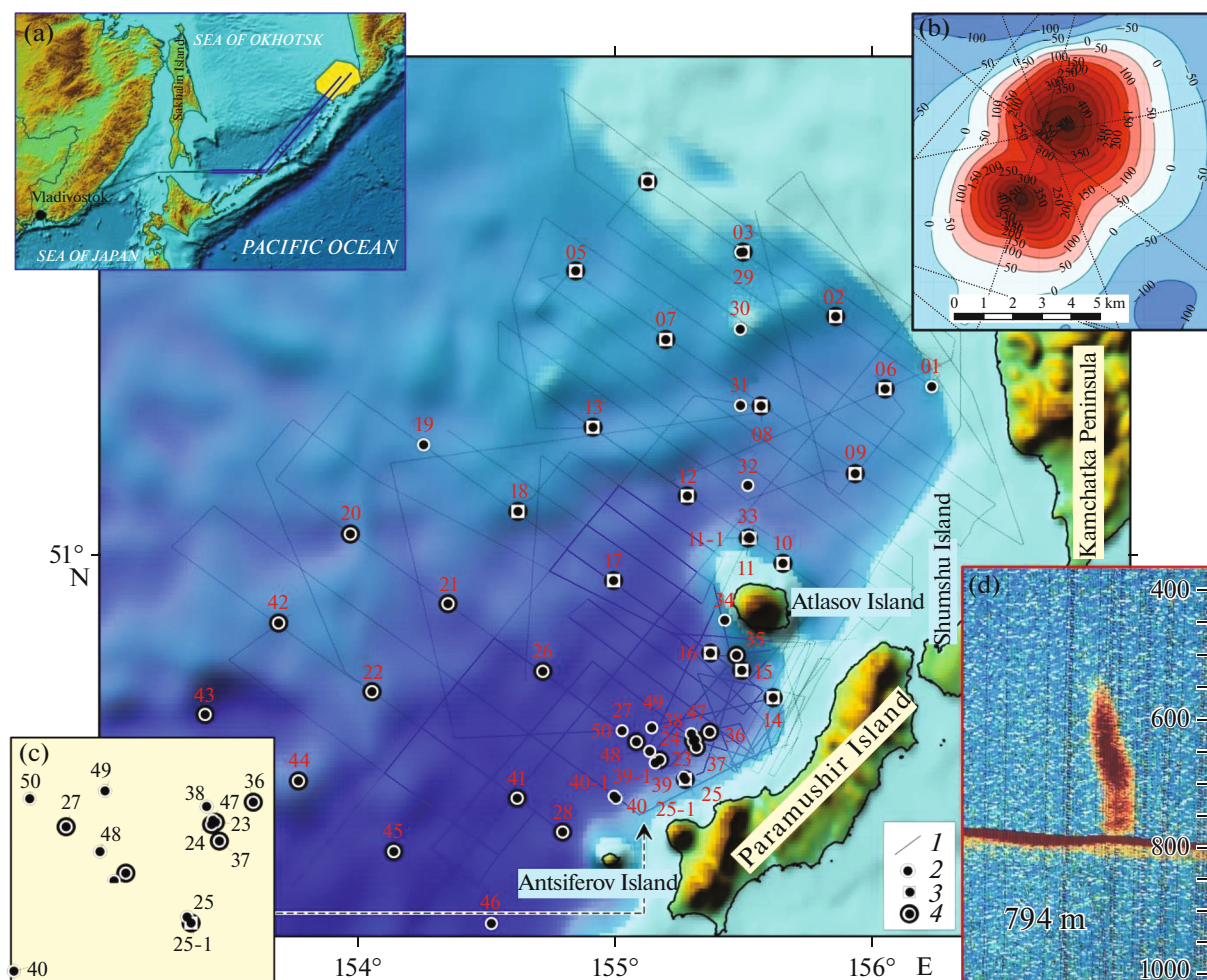


Fig. 1. Map of operations area during cruise 92 of the R/V *Akademik M.A. Lavrentiev*, April 17–May 26, 2021. (1) Geophysical survey profiles; (2–4) sediment sampling stations: (2) with gravity corer; (3) with box corer; (4) accompanied by hydrological profiling. Insets: (a) ship's route, regional profiles and position of the operations area; (b) hidden volcanic edifice reflected in anomalous magnetic field; (c) detailed sampling map near water area of Paramushir; (d) Paramushir gas flare.

and a graben-like structure reflected in a band of negative geophysical anomalies was traced in the central part of the study area.

Geochemical analysis of gas from cores and the water column in near Paramushir in the Sea of Okhotsk was carried out. Geochemical gas studies of this area have been significantly expanded, new data on the distribution of hydrocarbon gases have been obtained. According to preliminary results, two areas with high methane contents were identified in the bottom sediments. The first one is located in the north-eastern part of the study area, the second one is in the central part, next to the gas flare (station LV92-47). High concentrations, an increase in gas content towards the bottom of the core, and a high ratio of saturated to unsaturated hydrocarbons indicates a deep thermal gas source.

Lithological studies revealed that the sediments are mainly represented by clay and silt particles. Coarser-

grained sediments such as sand, gravel and pebbles are common in the coastal part of the water area. Gas-saturated sediments are characterized by a heterogeneous composition, and a smell of hydrogen sulfide.

Our expeditions commonly study the gaseous component of the atmosphere. Piccaro gas analyzers, kindly provided by the Department of Soil Science of the Far Eastern Federal University (Head of the Department—PhD, Associate Professor Nesterova) allowing real-time monitoring of the concentrations of methane, carbon dioxide and water vapor in the near-water atmosphere were installed on board.

Microbiological studies revealed three areas of thermophilic microorganisms were detected: near the Paramushir Island, around the Alaid volcano and in the vicinity of the Kamchatka Peninsula. Area with microorganisms near Alaid volcano and Paramushir Island are confined to smoking volcanoes, suggesting

that volcanic activity continues in the coastal shelves. The area near the Kamchatka Peninsula is located at a relative distance from land volcanoes. At the same time, methane content measured at stations with thermophilic organisms, corresponds to the background values.

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