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INFORMATION

Gas Geochemical Studies of Amur and Ussuri Bays (Sea of Japan) on the R/V *Professor Gagarinskiy*, Cruise Nos. 84 and 85

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Abstract—Information is provided on the results of gas geochemical and hydrometeorological studies of Amur and Ussuri bays, Sea of Japan, on cruises 84 and 85 of the R/V *Professor Gagarinskiy* in December 2022. For the first time for the winter period, synchronous measurements of greenhouse gases and atomic mercury were carried out in the surface marine boundary layer of Peter the Great Gulf, and new information was obtained on the seasonal characteristics of gas geochemical fields in the water column and bottom sediments.

Keywords: gas geochemistry, marine boundary layer, greenhouse gases, methane, bottom sediments, Amur Bay, Ussuri Bay, Sea of Japan

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Expeditionary marine research on the R/V *Professor Gagarinskiy* during cruise nos. 84 and 85 were carried out from December 1 to 15 in Amur Bay and from December 16 to 31 in Ussuri Bay, 2022. The expeditions were organized by the Il'ichev Pacific Oceanological Institute, Far Eastern Branch, Russian Academy of Sciences (POI FEB RAS) in accordance with the "Strategy for Development of Maritime Activity of the Russian Federation until 2030." The research was aimed at studying the gas geochemical and hydrometeorological state of the internal waters of Peter the Great Gulf-taking into account the influence of climatic, anthropogenic, and abiotic environmental factors.

The main objectives of the expeditions were to study the current state of gas geochemical fields in bottom sediments and the water column; organize daily marine stations for gas geochemical, hydrological, and meteorological monitoring in shallow-water shelf conditions; carry out areal associated gas geochemical, oceanological, and meteorological measurements to study gas exchange processes in the bottom–water–atmosphere system in waters of the inner shelf of Peter the Great Gulf (PGG). The expeditions included six researchers, among them four young specialists under the age of 35 (one undergraduate and two graduate students).

The integrated research methods included work at oceanographic stations and associated measurements along the vessel's path (Fig. 1).

At integrated oceanographic stations, sounding of the water column was carried out with an SBE-19 CTD probe (93 stations); water samples were taken with Niskin bottles, and bottom sediments were retrieved with a Box Core sampler (89 stations). Associated studies (1628 nautical miles of continuous profiling) included discrete sampling and onboard gas chromatographic analysis of surface seawater samples; continuous measurements of Hg(0), CH_4, CO_2, vapor H_2O, and meteorological parameters in the surface atmospheric layer were carried out.

For the first time for the winter season during freeze-up and changes in the hydrological regime within the waters of Amur and Ussuri bays, synchronous and complementary measurements of atomic mercury Hg(0) and greenhouse gases were taken in the atmospheric surface layer (CH_4, CO_2, H_2O), making it possible to model seasonal atmospheric transfer and verify possible sources of greenhouse gases in the land–sea and sea–atmosphere systems. The results formed the basis of the registered database [1] and complemented previous studies on deep water of the Sea of Japan [2, 3].

For the water area of Amur Bay, the range of CH_4 concentration fluctuations in the atmospheric surface layer, averaged over a five-minute period of time, during the study period varied from 2.017 to 2.081 ppm, and CO_2, from 418.84 to 453.90 ppm.

In the waters of Ussuri Bay, CH_4 concentrations in the atmospheric surface layer varied from 2.023 to 2.249 ppm. CO_2 concentrations varied from 420.06 to 467.34 ppm.

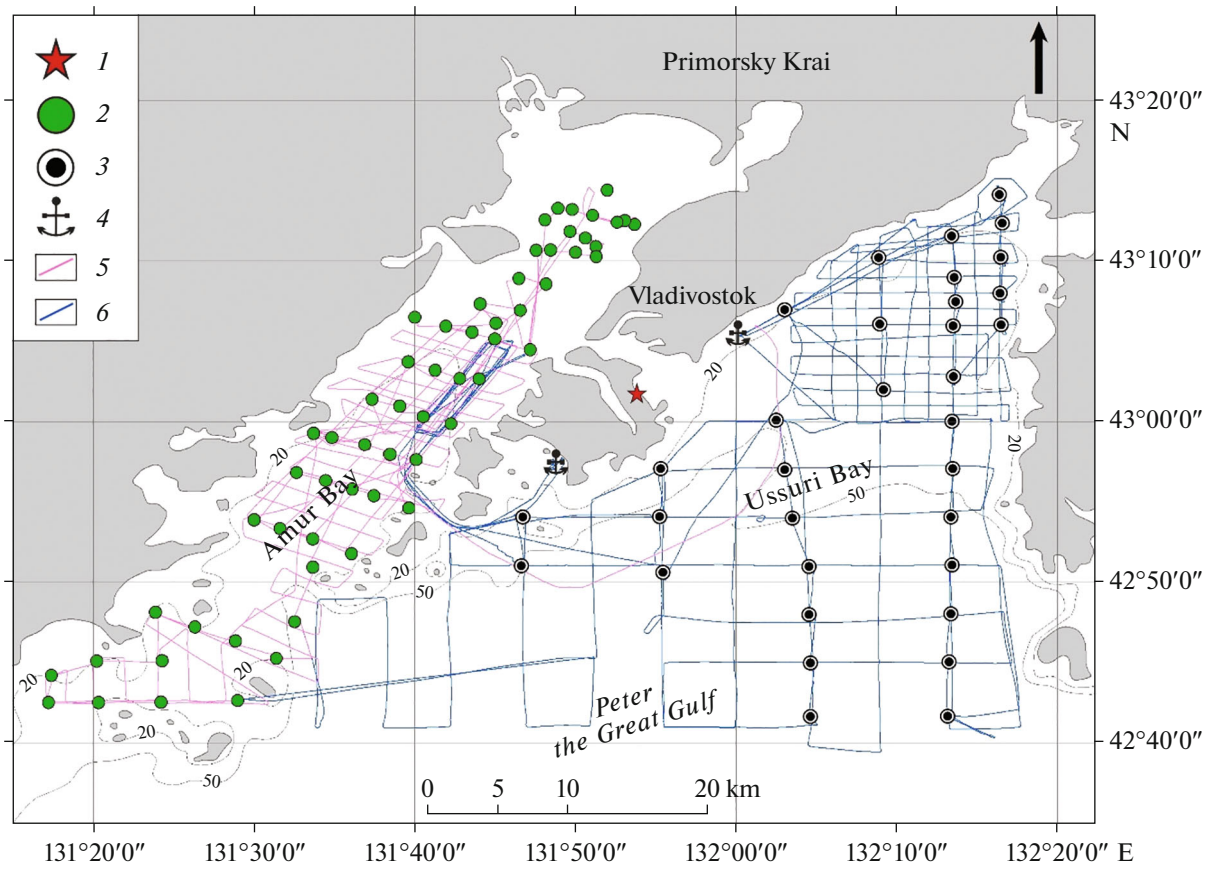

Fig. 1. Sketch map of research route and location of integrated oceanographic stations during cruises 84 (*2*) and 85 (*3*) of the R/V *Professor Gagarinskiy*, December 1–31, 2022. (*1*) Site of Far Eastern carbon test area of Primorsky krai; (*4*) stations of daily climatic and atmochemical monitoring; (*5*) route of cruise 84; (*6*) route of cruise 85.

Detailed gas geochemical sampling of the water column and bottom sediments significantly expanded the gas geochemical knowledge of new local zones of PGG with elevated of methane and carbon dioxide concentrations, both in bottom sediments and in the water column. The data are an important contribution to the development of marine scientific gas geochemical and climate research of the Russian Academy of Sciences in the Far Eastern seas of the Russian Federation.

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ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This work does not contain any studies involving human and animal subjects.

CONFLICT OF INTEREST

The authors of this work declare that they have no conflicts of interest.

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