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Geological and hydrological factors of dissolved methane distribution on the eastern shelf of Sakhalin Island

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Abstract. This paper continues a series of studies on the formation and distribution of dissolved methane, helium, and hydrogen on the shallow eastern shelf of Sakhalin Island. Numerous measurements, conducted during a comprehensive oceanographic expedition in 2024, revealed localized areas of gas emission from the seabed. The absolute maximum of dissolved methane was 139 nM/l; helium, 12 ppm; hydrogen, 135 ppm; and carbon dioxide, 0.47 percent, which could indicate the underlying source of these gases. It was shown that the formation of areas of high methane concentrations is controlled by a regional fault system. Tectonic activity has a significant impact on the gas distribution, which is important for understanding geochemical processes in a given area. Analysis of the data collected over different seasons showed a noticeable seasonal variability in the distribution of areas of high methane concentrations. During the warm season, these areas form within cold intermediate waters of the Sea of Okhotsk below the lower boundary of the seasonal pycnocline. Methane diffusion to the surface is limited due to the complex water structure and vertical diffusion processes. The studied water area of the eastern shelf of Sakhalin Island is affected by the East Sakhalin Current, which plays a significant role in the distribution of dissolved gases from the seabed sources. This emphasizes the complexity and versatility of the processes regulating the migration and distribution of gases in the marine environment of the western Sea of Okhotsk.

Keywords:
dissolved methane, helium, hydrogen, Sakhalin Island, eastern shelf, East Sakhalin Current, Okhotsk Sea

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