Geochemistry of pore water and gas in shallow sediments from offshore Primorsky Krai, Russia

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Offshore region of Primorsky Krai, Russia, in the northern Japan Sea is located in the boundary area between the shallower Tatar Trough on the north and deeper Japan Basin in the south. The marginal area of the Japan Sea has been characterized by the dense distribution of gas chimneys, which are identified by columnar blanking structureon acoustic records, e.g., W-S-E Tsushima Basin, Oki Trough, Joetsu Basin, Mogami Trough, and SW Sakhalin Island. Gas chimney structure delivers hydrocarbon gas, mainly methane, significantly from deep sediment to surface sediment, which may cause gas hydrate accumulation, carbonate precipitation, gas seepage, etc. Therefore it is one of the key structures controlling near-seafloor phenomena. In this research, we analyzed chemical compositions of pore water and gas collected from shallow sediments, off Primorsky, Russia (R/V Akademik M.A. Lavrentyev, Cruise LV81, 2018), and estimated the methane flux to characterize the geochemical environment near the seafloor. The sulfate concentrations linearly decrease with depth and the methane/ethane ratios are as low as ~100 at all sites, reflecting anaerobic oxidation of methane (AOM) is active at the sulfate methane interface (SMI). Decreases in calcium and magnesium were also obvious, indicating carbonate precipitation in response to alkalinity increase due to AOM. The methane flux estimated from SMI depths are generally high in the northern research area compared to southern area, in particular, at shallow gas chimney sites (SMI at ~1.5 mbsf, <1500 mWD). At the northern-most deep gas chimney sites, methane fluxes are relatively low. These results indicate that organic matter was primarily derived along the trough (from north to south) rather than the landward slope off Primorsky, and the methane generated in the sediment of deep area of the trough migrated through the porous layers to the shallow sites where the gas chimney is active. The geochemistry of pore water and gas depicts the shallow geochemical environments associated methane migration in research area.

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