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Author(s)	新宮原, 諒
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学 位 論 文 内 容 の 要 旨

博士 (環境科学)

氏 名 新宮原 諒

学 位 論 文 題 名

Study on relationship between CH₄ flux and wetting at taiga-tundra boundary in northeastern Siberia
using stable isotope ratios of CH₄

(北東シベリアタイガ - ツンドラ境界域における湿潤化前後のCH₄フラックスと
CH₄安定同位体比の利用)

Methane is one of the important greenhouse gases. Methane emission from natural wetlands is a major source of the atmospheric CH₄, and a significant driver of the interannual variation in the global CH₄ source depending on meteorological conditions such as precipitation. To understand relationship between CH₄ flux and wetting, this study observed interannual variations in chamber CH₄ flux, and concentration, $\delta^{13}\text{C}$, and δD of dissolved CH₄ in summers from 2009 to 2013 at the taiga-tundra boundary in the vicinity of Chokurdakh (70° 37' N, 147° 55' E) on the Indigirka River lowland in northeastern Siberia. Soil incubation experiments were also conducted to interpret $\delta^{13}\text{C}$ and δD of CH₄ to assess variations in CH₄ production and oxidation processes.

Methane flux showed large interannual variation in wet areas of sphagnum mosses and sedges (36–140 mg CH₄ m⁻² day⁻¹ as emission). Increased CH₄ flux was recorded in summer 2011 when a wetting event with extreme precipitation occurred. Although water level decreased from 2011 to 2013, CH₄ flux remained relatively large in 2012, and increased further in 2013. Concurrently, dissolved CH₄ concentration rose by one order of magnitude from 2011 to 2012, and increased further from 2012 to 2013.

Large variations in $\delta^{13}\text{C}$ and δD of dissolved CH₄ were observed in 2011, and less variations were seen in 2012 and 2013, suggesting both enhancement of CH₄ production and depression of CH₄ oxidation. These multi-year effects of wetting on CH₄ dynamics may have been caused by continued soil reduction across multiple years after wetting, suggesting that duration of water saturation in the active layer can be important for predicting CH₄ emission following a wetting event in permafrost ecosystem.