

東シベリアタイガ ツンドラ境界域におけるメタンフラックスと安定同位体比 Methane flux and its stable isotope ratios in a taiga-tundra ecotone in East Siberia

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One of the major sources of CH₄ is natural wetland and CH₄ is partly absorbed into forest soil. These CH₄ exchange between soil and the atmosphere is known to be spatially variable to great extent (Sachs *et al.*, 2010). Wetland is broadly distributed in the Arctic (Aselmann & Crutzen, 1989) and taiga-tundra ecotone (low and high shrub tundra) also covers significant area in the region (Kaplan & New, 2006). The vegetation in the taiga-tundra ecotone might be changed by climate change such as enhanced warming in the Arctic (Walker *et al.*, 2006) and eventually CH₄ flux as well, which is a strong greenhouse gas. In order to estimate CH₄ emission from a region in the taiga-tundra ecotone, it is necessary to observe CH₄ flux not only at a typical tundra site but also at multiple sites including taiga area. Such observation had been carried out in other region such as West Siberia (Flessa *et al.*, 2008), but not yet in East Siberia. The objective of this study is (1) to establish new observation sites in a taiga-tundra ecotone in East Siberia and observe CH₄ flux at each vegetation landscape and (2) to clarify the controls of CH₄ flux in the ecosystem.

We observed CH₄ flux by closed chamber method in Jul 2009-2011 at 4 new sites (separated for tens of km) with different vegetation in the taiga-tundra boundary of Indigirka lowland near Chokurdakh (70N, 148E), Russia. The region has a typical tundra station, where CH₄ flux had been observed since 2004 (van Huissteden *et al.*, 2005). We set new sites denoted as V (taiga-like), K (typical boundary), B (tundra-like), where tree mounds with moss cover (*Sphagnum spp.*) and with larch, wet area with sedges (or *Sphagnum*) and frequently with surface water were distributed in a patchy way. We also set site F (floodplain) in 2010. Along with flux observation, we measured oxidation reduction potential (ORP), soil temperature, soil moisture, and thaw depth as potential controls of CH₄ flux. In 2011, we also measured CH₄ concentration in surface water and in soil pore (at ca. 15 cm) in wet areas, and delta-13C and delta-D of these dissolved CH₄ and emitted CH₄ to clarify the production, transport, and oxidation process. GC-FID was used to analyze CH₄ concentration and GC/GC/C(TC)/IRMS for delta-13C and delta-D of CH₄.

The observed CH₄ flux was -0.23~7.0 mgC m⁻² h⁻¹ and different among vegetation types. At tree mounds and river terrace (F site), the soil was drier with relatively higher ORP than wet areas and CH₄ emission wasn't observed. At K wet area (sphagnum/sedge), where dead larch with flat Sphagnum cover on ground could be seen and regarded vegetation succession was taking place, small CH₄ emission was observed (2.1 mgC m⁻² h⁻¹ at maximum). At V, B sedge wet area, the largest emission was observed (0.05~7.0 mgC m⁻² h⁻¹). CH₄ flux didn't correspond with CH₄ concentration in surface water, but the flux was large when CH₄ concentration in soil pore was high, indicating that the contribution of CH₄ diffusion throughout surface water is small and that CH₄ could be emitted from soil through vascular plants. CH₄ flux was positively correlated with soil temperature at wet areas, as well as CH₄ concentration in soil pore. CH₄ flux at K sedge wet area, however, was almost constant and had no correlation with CH₄ concentration in soil pore. In 2011, when the water level of the river system was remarkably high and the soil was wet, the largest CH₄ flux was observed with low ORP. The observed delta-13C of CH₄ in soil pore was extremely high (-59~-47 per mil), which indicates the delta value was affected by diffusion or oxidation in the soil. Delta-D-delta-13C plot supported the CH₄ transportation by plants. To estimate CH₄ flux of the region, it's necessary to consider not only tree mound and sedge wet area but also vegetation succession. If vegetation changes from tree mound to succession area, or from succession area to sedge wet area, regional CH₄ flux might increase and cause positive feedback on climate.

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