

Sulfur denitrification and chemical denitrification in sulfide rich soils in Hachirogata polder

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[Introduction] Human activities have increased reactive nitrogen (i.e. NO_3^- , NO_2^- , NH_4^+ etc.), resulted in increasing nitrogen loading to ecosystems (Galloway and Cowling, 2002). Denitrification, the reactive nitrogen removal process in ecosystems, is diverse processes not only biological denitrification by autotrophic and heterotrophic denitrifiers, but also chemical denitrification. Sulfur denitrification is a process of reducing NO_3^- to N_2 using reduced sulfur (sulfide) as an electron donor by autotrophic bacteria such as *Thiobacillus denitrificans* (Burgin et al., 2007). The sulfide is oxidized to SO_4^{2-} through sulfur denitrification. But, chemical denitrification is a process that reduces NO_2^- to NO or N_2O by chemical reactions (Nelson 1970, Bollang 1973), and it releases more NO in a low pH (4.6~6.3) condition (Ventera et al., 2005).

Generally, coastal sediments contain much sulfide which has been formed at seafloor under anoxic condition (Wijsman et al., 1972). Hachirogata polder located at a coastal area in Akita prefecture, was reclaimed from a brackish water lake and have much sulfide in the subsoil. Agricultural activities supply NO_3^- to the subsoil in the polder. Furthermore, the sulfide exposed under oxic condition can be oxidized, resulting in a decrease of soil pH. Therefore, our hypothesis were (1) sulfur denitrification will occur using sulfide as an electron donor for denitrification and (2) chemical denitrification also may occur under lower pH condition due to an oxidation of sulfide in the soils of Hachirogata polder.

[Method] The soils were sampled at three paddy fields (A-15, A-19, B-4) in Hachiroigata polder on May, 2017. The samples were collected from the depth of 0~50 cm by hand auger at three sites in each field and divided (Layer 1: surface soil, Layer 2: ~25 cm, Layer 3: 25~37.5 cm, Layer 4: 37.5~50 cm). Fresh soils (about 15 g) and 50 mL of treatment water were added to 150 mL bottle. Three treatments water was prepared: IEW(Ion exchanged water), N (KNO_3 : 5 mgN / L), N+S ($\text{KNO}_3+\text{NaS}_2\text{O}_3$: 5 mgN / L, 10 mgS/L). After adding, the gas-phase was replaced with N_2 gas and incubated for 24 hours by shaking. After the incubation, we measured pH, NO_3^- , NO_2^- , SO_4^{2-} , $\text{S}_2\text{O}_3^{2-}$ in water solution and NO , N_2O in the gas phase. The air-dried samples were analyzed for soil pH (H_2O , KCl, H_2O_2), water soluble organic carbon (TOC) and total sulfur (T-S).