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Heavy-metal concentration of forest soil in Chichibu region, Saitama prefecture

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Total nitrogen concentration in stream water in the upstream regions of Ara river is increasing because of nitrogen saturation presumably caused by nitrogen atmospheric deposition. Atmospheric emission of heavy metal is also increasing with the developments in industry. If air mass containing high nitrogen emission flows in forested ecosystems from urban area and causes nitrogen saturation, heavy metal derived from human activities should also deposit on forested ecosystems and contaminates stream water and soil. In addition, leaching of nitrogen may be altered by the deposition of heavy metal through disturbing the metabolism of soil microbe.

To evaluate the atmospheric heavy metal per se and the effect of heavy metals to the nitrogen leaching, we compared Cr, Zn, Pb, Cu and Sb concentration in 1M-HCl soil solution. Sampling was performed twice: one before rainfall and the one after the rainfall. Soil samples were collected from the trench in Chichibu region where the nitrogen saturation is reported. In addition, we measured Cr, Zn, Pb, Cu and Sb concentration in 1M-HCl soil solution at 8 points near the stream of various stages of nitrogen saturation.

Decrease ratio of heavy-metal concentration at the trench between before and after rainfall (Cr 53%, Zn 49%, Pb 10%, Cu 15%, Sb 2%) was positively correlated with ionization tendency (Cr > Zn > Pb > Cu > Sb). It is suggested that elements with high ionization tendency leaches easier than that with low ionization tendency. It is contemplated that the effect of heavy metal on nitrogen metabolism of soil microbe is in the same range among the 8 points because heavy metal concentration in soil solution near the stream was nearly identical at every point. Thus, the difference of nitrate concentration in stream water at the 8 points may be caused not by the effect of heavy metal on nitrogen metabolism of soil microbe but by the direct reflection of the amount of atmospheric nitrogen deposition.

Soil Sb concentration at the headstream area of Ara river (1.9ppm) was higher than that at other areas (0.2-0.6ppm). This may be the effect of Chichibu mine, which had been operated at the headstream area of Ara river. It is recorded that bournonite (CuPbSbS_3) and jamesonite ($\text{Pb}_4\text{FeSb}_6\text{S}_{14}$) were mined at Chichibu mine. There is a possibility that Sb emitted from the mine is stay behind or the base materials of the soil of the headstream area of Ara river have much Sb.

For these reasons, we considered that heavy metal has little effect on the nitrogen leaching to the stream water and nitrogen concentration in stream water corresponds to the amount of atmospheric nitrogen deposition.

Keywords: forest soil, heavy-metal contamination