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Nitrate behaviors and its transportation time scale in unsaturated zone under farmlands with different fertilization log in Kumamoto region, southern Japan

Azusa Okumura (2), Takahiro Hosono (1), and Jun Shimada (2)

(1) Kumamoto University, Priority Organization for Innovation and Excellence, Kumamoto, Japan , (2) Kumamoto University, Graduate School of Science and Technology, Kumamoto, Japan

An application of fertilizers and manure often caused an increase of nitrate concentration in groundwater in the agricultural area. The study area, Kumamoto, is the field facing this type of problem. Previous studies using nitrogen-oxygen isotope ratios in nitrate showed that accumulation of chemical fertilizers is the major factor for observed nitrate contamination. However, once it loaded nitrogen compounds may change its form and isotopic composition during transportation within unsaturation zone prior to reach the aquifer. However, such kind of knowledge is still rarely accumulated. To clarify the behavior and transportation manner of nitrogen in the unsaturated zone, we analyzed the nitrogen-oxygen isotope ratios of the extracted soil water of the unsaturated zone soils from the farmland having different fertilization logs. In addition, we attempted to verify the origin of nitrate in soil water by comparing with previous isotopic results. The plateaus-like topography of the study area is consists of the pyroclastic flow deposits. Land use is mainly farmland and this area is a major source of nitrogen load and transport route into the aquifer. Nitrate concentration in groundwater at terraces recharge area has been reported about 40 mg/L. Drilling survey carried out in the unsaturated zone soil on 4 farmlands with the different land use logs in such terraces. Drilling points S1 and S2 were treated by both slurry and chemical fertilizers, on the other hand, point C1 and C2 were applied chemical fertilizers only. The drilling depth was up to 14-15 m, and soil samples were kept on evacuated condition after sectioning into 10 cm interval. The soil water was extracted using a centrifuge machine. The extracted soil water was measured for the nitrogen-oxygen isotope ratios in nitrate and major ions concentrations. All cores showed high nitrate concentrations in the surface layer (260, 440, 172 and 244 mg/L for S1, S2, C1, and C2 respectively). The concentrations became lower downwards for all cores. However, the concentrations were still high even at the point of 10 m (about 100-200 mg/L) for all cores. In the S1 and S2 cores nitrogen and oxygen isotopic results indicated occurrence of volatilization and nitrification in the surface layer, but in the C1 and C2 cores this signature was not clearly shown. The isotope compositions become homogenized downwards to have specific values depending on fertilization logs. This result is consistent with the previous studies. In the presentation, we will present detailed discussions regarding the behaviors of the isotope ratios in nitrate.