Geophysical Research Abstracts
Vol. 18, EGU2016-5200, 2016
EGU General Assembly 2016

Chase the direct impact of rainfall into groundwater in Mt. Fuji from multiple analyses including microbial DNA

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A huge amount of groundwater is stored in subsurface environment of Mt. Fuji, the largest volcanic mountain in Japan. Based on the concept of piston flow transport of groundwater an apparent residence time was estimated to ca. 30 years by 36Cl/Cl ratio (Tosaki et al., 2011). However, this number represents an averaged value of the residence time of groundwater which had been mixed before it flushes out. We chased signatures of direct impact of rainfall into groundwater to elucidate the routes of groundwater, employing three different tracers; stable isotopic analysis (delta 18O), chemical analysis (concentration of silica) and microbial DNA analysis. Though chemical analysis of groundwater shows an averaged value of the examined water which was blended by various water with different sources and routes in subsurface environment, microbial DNA analysis may suggest the place where they originated, which may give information of the source and transport routes of the water examined. Throughout the in situ observation of four rainfall events showed that stable oxygen isotopic ratio of spring water and shallow groundwater obtained from 726m a.s.l. where the average recharge height of rainfall was between 1500 and 1800 m became higher than the values before a torrential rainfall, and the concentration of silica decreased after this event when rainfall exceeded 300 mm in precipitation of an event. In addition, the density of Prokaryotes in spring water apparently increased. Those changes did not appear when rainfall did not exceed 100 mm per event. Thus, findings shown above indicated a direct impact of rainfall into shallow groundwater, which appeared within a few weeks of torrential rainfall in the studied geological setting. In addition, increase in the density of Archaea observed at deep groundwater after the torrential rainfall suggested an enlargement of the strength of piston flow transport through the penetration of rainfall into deep groundwater. This finding was supported by difference in constituents of Archaea by predominance of Halobacteriales and Methanobacteriales, which were thought to be relatively tightly embedded in geological layer and were extracted from the environment to the examined groundwater. Microbial DNA thus could give information about the route of groundwater, which was never elucidated by analysis of chemical materials dissolved in groundwater.