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Microbes Characteristics in Groundwater Flow System in Mountainous Area

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We focus on a possibility of microbes as a tracer for groundwater flow investigation. Some previous papers showed that the total number of prokaryotes in groundwater has correlation with depth and geology (Parkes *et al*., 1994; Griebler *et al.*, 2009; Kato *et al.,* 2012). However, there are few studies investigating both microbe characteristics and groundwater flow system. Therefore, we investigated a relationship between the total number of prokaryotes and age of spring water and groundwater. Intensive field survey was conducted at four mountainous areas, namely Mt. Fuji (volcano), a headwater at Mt. Setohachi, a headwater at River Oi and a headwater at River Nagano underlain by volcanic lava at Mt. Fuji, granite at Mt. Setohachi and sedimentary rock at River Oi and River Nagano. We collected totally 40 spring water/ groundwater samples in these mountainous areas in October 2015, August, October and November 2016 and analyzed concentration of inorganic ions, the stable isotopes of oxygen – 18, deuterium, CFCs and SF_6. Also, we counted prokaryotic cells under the epifluorescence microscopy after fixation and filteration.

The total number of prokaryotes in the spring water/ groundwater ranged from 1.0×10^2 to 7.0×10^3cells mL^{-1} at the Mt. Fuji, 1.3×10^4 to 2.7×10^5cells mL^{-1} at Mt. Setohachi, 3.1×10^4cells mL^{-1} at River Oi and 1.8×10^5 to 3.2×10^6cells mL^{-1} at River Nagano. The SF_6 age of the spring water/ groundwater ranged from 8 to 64 years at Mt. Fuji, 2 to 32.5 years at Mt. Setohachi, 2.5 years at River Oi and 15 to 16 years at River Nagano.

The total number of prokaryotes showed a clear negative correlation with residence time of spring water/ groundwater in all regions. Especially the prokaryotes number increased in the order of 10^2 cells mL^{-1} with decreasing of residence time in approximately 10 years in the groundwater and spring water with the age less than 15 years.