

Role of bedrock groundwater in rainfall-runoff process in a small headwater basin underlain by volcanic rock

Sho Iwagami[1]; Maki Tsujimura[2]; Takahiro Kawakami[3]; Takeshi Masubuchi[4]; Jun Shimada[5]; Yuichi Onda[6]; Tadashi Tanaka[7]

[1] Geoenvironmental Sci., Tsukuba Univ; [2] Grad. Sch. Life Environ. Sci., Univ. Tsukuba; [3] Environmental Sci., Tsukuba Univ; [4] Master Prog in Env, Tsukuba Univ; [5] Fac. of Sci., Kumamoto Univ.; [6] School of Life&Envirom. Sci., Univ. of Tsukuba; [7] GS, Life & Environ. Sci., Univ. Tsukuba

In order to investigate the role of bedrock groundwater in rainfall-runoff process, hydrometric, tracer, and potential approaches are applied in a small forested catchment situated in Shiranui, Kumamoto prefecture, south-west Japan. The area is covered with a thick soil layer underlain by Tertiary volcanic rock; Andesite. Concentrations of major chemical constituent were analyzed on spring water, rain water, soil water and bedrock groundwater.

During the humid period, delayed runoff peak after the first runoff peak accompanied with rainfall peak were observed several times. Concentrations of major ions, oxygen-18 and deuterium in spring water decreased with the peak runoff coincided with the rainfall peak, whereas nitrate concentration increased. During the delayed runoff peak, concentrations of bicarbonate and silica increased, whereas the nitrate concentration in the spring water decreased. Hydrograph separation analysis using oxygen-18 and silica as tracers showed rain and soil water were dominant components in the spring water during the first runoff peak, whereas the bedrock groundwater and soil water were dominant components during the delayed second runoff peak. Also, the observed subsurface water potential data supported the results revealed by the tracer approach.

Considering the silica concentration, the spring water would be recharged by the groundwater originated from the groundwater table located in the bedrock. During the rainstorms, the water table rises up to the soil layer and the hydraulic gradient increases. Thus, the hillslope soil water and the bedrock groundwater contribute to spring runoff. The present study made clear the mechanism of the bedrock groundwater contribution to the runoff based on the observed evidences.