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Evaluation of mountain block recharge using sulfur hexafluoride in Ono basin, Fukui prefecture, Japan.

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In the mountain-plain transitional areas, the possible sources of the groundwater recharge are the rainfall on the plain and the surface water/ the groundwater at the headwaters. Previously, the mountain block recharge has been supposed to be not dominant, because the faults / geological borders generally exist at the boundary between the mountain and the plain. In Ono basin, Fukui Prefecture, north-west Japan, previous papers showed that the surface water from the mountain is a dominant source of the groundwater in the plain. However, the observed groundwater contour map suggests that the mountain block recharge also would contribute. Thus, we evaluated the role of the mountain block recharge for the basin groundwater using sulfur hexafluoride (SF_6)as a tracer.

Ono Basin itself has an area of approximately 75 km^2, and whole watershed of Ono Basin has an area of 942.5 km^2 with an altitude ranging from 154.8 m to 1972.1 m. We sampled the groundwater at 20 monitoring wells and the surface water at 2 locations of River Mana at Ono in July and August 2018. We also observed the depth of the groundwater table at the wells to construct the groundwater contour map in the basin. The SF_6 concentration, inorganic constituent concentrations, stable isotopic compositions of the deuterium and the oxygen-18 were determined on all water samples.

The SF_6 concentration in the groundwater ranged from 3.1 fmol to 6.3 fmol, whereas that of the river water ranged from 2.6 fmol to 3.2 fmol. Also, the SF_6 concentration of the groundwater was lower in the southwestern area of the basin as compared with that of northern area and area nearby the river, suggesting the contribution of mountain block recharge is dominant in the southwestern area of the basin. We applied an End Member Mixing Analysis (EMMA) using SF_6 as a tracer and evaluated the contribution ratio of the mountain block recharge to the total recharge in the basin. The contribution of the mountain block recharge was estimated to be ranging from 19% to 99%, whereas that of the river water was estimated to be ranging from 1% to 81%. Especially, the mountain block recharge ratio showed more than 95% at the mountain-plain transitional area in the southwestern area of the basin. Our results indicate that the mountain block recharge is an important recharge source of groundwater in the basin.