Relationship between geology and ^{222}Rn concentration in hot springs and groundwater around Kagoshima city, Japan

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Radon (^{222}Rn) is a radioactive noble gas that occurs naturally in Earth's crust as an intermediate step in the uranium series radioactive decay chain. Radon is highly soluble in water, and thus is very mobile through groundwater and fluid flow in the crust. Radon release rate mainly depends on the physical properties of rocks/aquifers, such as surface area and porosity. Thus, the concentration of radon in crustal fluids and groundwater can provide clues for understanding the state of underground including host rocks, faults and the deformation status. Radon concentrations has been monitored as precursory indicator of earthquakes (e.g. Ulmov and Mavashav, 1971; Wakita et al., 1980; Igarashi et al., 1995; Kuo et al., 2006; Tsunomori and Tanala, 2014). Groundwater radon concentration has come to be used to investigate the existence of active faults, on the basis of the larger surface areas in fault zone than massive rock (Malgrange and Gleeson, 2014; Tsunomori et al., 2017).

We surveyed hot spring and groundwater radon concentrations in the vicinity of Kagoshima city area to examine relationship with the geology such as the formation and active fault. Temperature of hot springs suggested that they conform to popular geothermal gradient, suggesting that the hot springs are currently not affected by heat from magma under Aira caldera and old volcanic ejecta. Higher radon concentration in groundwaters discharged from porous pyroclastic flows than that in hot springs from hard bed rocks are obtained. The radon concentration distribution show that the hot springs along the active faults and faults in bed rock have higher concentration, suggesting that the hot springs may be discharging through active and inactive faults. Several hot springs along the faults are considered to be a mixture of meteoric water and magma related water by stable oxygen and hydrogen isotope data, which means that magma related waters are upwelling through active and inactive faults. These results suggest that radon concentration distribution of the hot springs and groundwater strongly associate with their hosting geology and geological structure. Using the relationship, we also estimate the depth of pollution source in several wells.

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