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Temporal change and factor analysis of radon concentrations in discharged gas of an active volcano

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Clarifying geologic structure and property is important to resource exploration, utilization of underground space and disaster prevention against earthquake. In this study, we adapted radioactive surveying, which has been widely for investigations of active fault, surface geology, groundwater, and geothermal to identify predominant factors on radionuclide concentration in the top soils in tectonically active areas. Possible factors are earthquake, tide, groundwater, temperature and pressure at deep parts, and fault. These factors are contained in active volcano areas and therefore, a fumaroles site at the western side of Mt. Aso was selected. Target nuclide was Radon (^{222}Rn), which is inactive chemically and can exist in only gas condition among all radioactive nuclides. Ionization chamber method was used to detect alpha rays accompanying the decay of Rn: electric charge and current are detected as output signal of electric voltage by ionization effect. Rn gas was pumped up from 1 m depth and Rn concentrations had been measured continuously at 10 minute interval from 11 September 2001 to 15 January 2004.

Rn concentrations showed large and periodical change with time and had strong correlation with daily average temperature. The effect of temperature was removed from the original data and the residual components were assumed to be determined by tectonic factors. By comparing the residual components with the main nine components of earth tide calculated using GOTIC2 (Matsumoto *et al*., 2001), the tidal force was clarified to have strong effect on Rn concentration because the residual components became large generally with the increase of the tidal force. In addition, a relationship between the volcanic earthquakes and the rise of residual components was found.

To confirm the effect of tidal force on Rn concentration, a laboratory experiment was conducted using granitic soils filled in a box and a granite sample as a Rn source in the soils. Rn concentrations on surface were measured and confirmed to have a relationship with the earth tide. Consequently, control factors on Rn concentration were identified as earthquake activity and earth tide in deep depths, and the temperature was considered to change Rn concentration near the surface by affecting the velocity of gas rise.

Keywords: radon, temperature, volcanic earthquake, earth tide, Mt. Aso