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Radiochemical Techniques Applied to the Study of Volcanic Gases

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Using natural radioactivities, we can study the origin and the underground transport behavior of the volcanic gas. For example, two radioactive isotopes of radon are contained in the gas, and their concentrations are considered to be related to the migration time and mixing of various gases existing underground. Those two isotopes offer two different time scale for the study of the gas.

The chemical inert gas, Radon, has $^{222}Rn(T_{1/2}=3.82\,d)$ and $^{220}Rn(T_{1/2}=55\,s)$ isotopes. They inevitabley co-exist in the volcanic gas and are detected simultaneously. We have developed a simiple and reliable method for thier determination using an especially designed portable liquid scintillation counter. Because of the short half life of ^{220}Rn, a method for rapid sampling, sample preparation, activity measurement, and data analysis for the absolute determination of the concentration was examined.

On the other hand, we have also collected the Rn decay products from the gas and, after a simple chemical separation, measured the radioactivities of $^{212}Pb(T_{1/2}=10.64\,h)$ and $^{214}Pb(T_{1/2}=26.8\,m)$ with a liquid scintillation counter. We have compared this indirect method with the above direct method of the ^{222}Rn and ^{220}Rn measurement.

Carbon dioxide is the principal component of volcanic gas, and it contains the radiocarbon $^{14}C(T_{1/2}=5730\,y)$. It is expected that the ratio of ^{14}C to ^{13}C(or ^{12}C), gives some useful information on the amount of the CO_2 produced by the strongly acidic magnetic gas near the surface or on the mixing of atmosphere with the volcanic gas. We have tried the radiocarbon measurement using the method of accelerator mass spectroscopy.

We tested those methods in the field for the study of hot spring gas and volcanic gas at 8 geothermal areas in Japan.

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