

Diffusive CO₂ degassing through volcanic body of Unzen volcano

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Groundwater dissolves a large amount of carbon through diffusive degassing from deep sources. We carried out the geochemical study of groundwater and soil gas to obtain magmatic CO₂ flux through the body of Unzen volcano and its distribution between soil gas and groundwater. Here, we compare the spatial variations of magmatic CO₂ flux from soil gas and magmatic carbon concentration in groundwater deduced from carbon isotope ratios, and discuss process of CO₂ degassing through volcanic body.

Soil gas survey was carried out covering whole the Shimabara peninsula. At the field survey, CO₂ and O₂ concentration at the depth of 30cm, and CO₂ flux from soil surface were measured using a Gas detector (GasTech), O₂ meter with galvanic cell (Yokogawa) and a portable CO₂ flux meter (West System: an accumulation chamber method), respectively. Soil gas was taken to an aluminized plastic bag (3L), pre-evacuated glass bottle (150 or 100mL) or vial (10mL) for δ¹³C and δ¹⁴C measurements.

Groundwater sample was taken from wells of city-water, hot springs and private houses to plastic bottles. Chemical composition and isotope ratios (δD and δ¹⁸O) of water were measured by ion chromatography and IR-MS using the Water-Gas equilibrium method, respectively.

The δ¹³C values were measured by IRMS with a dual inlet system or CF-GC. Radiocarbon was measured by AMS system. An acid CO₂ extraction method was used for groundwater.

The magmatic CO₂ contribution in soil gas was estimated using a mixing model with carbon isotopic mass balance among magmatic, biogenic and atmospheric sources. For the groundwater samples, we used δ¹³C signature of DIC.

All the CO₂ concentration in the soil gas, the flux from soil surface and the DIC concentration were indicated to be relatively higher inside Unzen graben, especially east area. The results suggest that magmatic contribution is high in the east area. For quantitative discussion, magmatic CO₂ contribution in soil gas and groundwater must be estimated. The high magmatic CO₂ flux from soil and magmatic carbon concentration in groundwater is located around lava dome, Unzen Spa, Obama Spa and eastern flank of graben (including Shimabara Spa). At the former two areas, it is considered that magmatic CO₂ flux from fumarolic degassing zones is high.

The high magmatic contribution is located along the active faults in the eastern area. Our observation across a fault also shows high CO₂ concentrations and high δ¹³C values in soil gas. Therefore, magmatic CO₂ likely upwells along the fracture zone in fault system inside Unzen graben.

The magmatic carbon flux transported by groundwater is estimated for 24 tons/day (Kazahaya et al., 2004). As for soil CO₂ flux, averaged value in eastern area is 12.6 g/m²/day, corresponding ~240 tons/day. We are estimating magmatic contribution in CO₂ flux, and will show the magmatic CO₂ flux from soil at the joint meeting.