

Soil diffuse degassing around the active crater lake at Kusatsu-Shirane volcano: Measurements of helium isotope and gaseous elemental mercury of soil gases

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Kusatsu-Shirane is one of the most active volcano in Japan in terms of persistent release of volatile as emissions of hot spring waters. At the top of this volcano, the Shirane pyroclastic cone contains a hyper-acidic hot crater lake, locally referred to as Yugama, which is a famous sightseeing spot. At the southern flank of the Shirane pyroclastic cone, there have been lateral phreatic eruptions since 1000 years ago, although this area is almost covered by vegetation. This area around Yugama crater lake is easy of access because of a road traveling across the top of Kusatsu-Shirane volcano. Thus, evaluations of risk of lateral volcanic eruption are critical. To assess shallow permeability structure we have carefully sampled soil gas at 1 m depth from ground surface around the southern flank of the Shirane pyroclastic cone. Our precise measurements of helium isotopes using a mass spectrometer (Sumino et al., 2001) revealed that soil gas at the southern flank contains helium which is mixture of magmatic gas and crustal components. This area corresponds to the area where we have detected emissions of gaseous elemental mercury (GEM). On the other hand, helium isotopes of soil gas sampled outside the southern flank is comparable to that of air, and GEM fluxes from ground surface correspond to the value of representative atmospheric air in Japan. Therefore, we believe that volcanic gas containing magmatic components is being supplied from a hydrothermal reservoir to the ground surface through a low permeability zone such as a fracture leading lateral eruptions. Although there are no thermal manifestation over the last 50 years, it is likely that phreatic eruption occur in future at the southern flank. We believe soil gas is useful to evaluate possibilities of the area where explosion may occur in future. Both helium isotopes and GEM fluxes may change in response to changes in chemical/physical parameters in the hydrothermal reservoir, thus, monitoring of helium isotope of soil gas and GEM flux from ground surface are valuable means of evaluation of lateral eruption at the southern flank of Shirane pyroclastic cone.

Keywords: Kusatsu-Shirane volcano, Soil diffuse degassing, Helium isotope, Lateral eruption, Shallow permeability structure