Temporal variation of He isotopes in fumarolic gases at Mt. Hakone, Japan

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Volcanic and seismic activity was intensified at Mt. Hakone in 2015. Earthquake swarm activity was observed in the end of April 2015, which was followed by small eruptions at the Owakudani geothermal area from June to July. Eruptions and seismic activity had been frequently observed till about October 2015, and the activity became calm in the end of the year. From May 2015, we have been investigating $^{3}He/^{4}He$ ratios in fumarolic gases collected at two sites in the Owakudani geothermal area, located at Mt. Kamiyama which is one of the central cones of Hakone caldera. One fumarolic gas (T) is located near the parking of the geothermal area, and another fumarolic gas (S) is located on the north flank of Mt. Kamiyama, 500m far from the fumarole T. Helium isotopes in collected gases were measured with Helix-SFT or VG5400 mass spectrometer housed at Atmosphere and Ocean Research Institute. $^{3}He/^{4}He$ ratios in samples were calibrated against atmospheric value (R_a: $^{3}He/^{4}He = 1.38x10^{-6}$). Since He isotopes are useful magmatic fluid tracers, temporal variations of $^{3}He/^{4}He$ ratios may provide information about volcanic activity. $^{3}He/^{4}He$ ratios at two fumaroles slightly increased until August 2015, also after the small eruptions from June to July. The corrected $^{3}He/^{4}He$ ratio at the fumarole T increased from 6.53 R_a (June) to 6.72 R_a (August), while that of the fumarole S increased from 6.57 R_a (May) to 6.76 R_a (August) in 2015. After that, the ratios at two fumaroles started to decrease. Corrected $^{3}He/^{4}He$ ratios at fumarole T and S decreased to 6.37 R_a (October 2016) and 6.45 R_a (September 2016), respectively. These variations may reflect hydro-volcanic activity at Mt. Hakone. At Mt. Ontake, the magmatic high He isotopic ratio was supplied into geothermal systems associated with excess water vapor which could have provided the driving force for the 2014 eruption (Sano et al., 2015). There is a possibility that elevation of He isotopic ratios may be related to vapor accumulation and potential activation of Mt. Hakone, while decrease in the ratios may reflect inactivation. We will also present N and Ar isotope data, and discuss gas geochemistry along the volcanic activity of Mt. Hakone.

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