Long-term monitoring of helium isotope ratio of the volcanic gas and hot spring water at Izu-Oshima volcano, Japan

K. KAWANA[1*], H. SUMINO[1], K. YAMANE[2], T. MORI[3], A. SHIMIZU[4], K. NOTSU[5] AND P.A. HERNÁNDEZ[6]

[1] Department of Basic Science, University of Tokyo, Japan (*correspondence: kawana@igcl.c.u-tokyo.ac.jp)
[2] College of Arts and Sciences, University of Tokyo, Japan
[3] Geochemical Research Center, University of Tokyo, Japan
[4] Tokyo Metropolitan Industrial Technology Research Institute, Japan
[5] Center for Integrated Research and Education of Natural Hazards, Shizuoka University, Japan
[6] Instituto Volcanológico de Canarias, Spain

Among noble gases, helium is regarded as an useful tracer for the volcanic activity because isotope ratio of helium ($^3He/^4He$) exhibits unique values corresponding to the origin (e.g., 7–8 R_A in the mantle where 1 R_A denotes atmospheric $^3He/^4He$ of 1.4×10^{-6} [1]). Few studies have reported pre-eruptive $^3He/^4He$ anomalies [2,3], suggesting the increase of supply of the magmatic helium into the hydrothermal system preceding eruption. However, what processes result in the temporal variation of $^3He/^4He$ ratio is still unknown. To understand the precursory phenomena more accurately, long-term monitoring of the $^3He/^4He$ ratio for both volcanic rest and unrest periods are necessary. We present the temporal variation of $^3He/^4He$ ratio of volcanic gases and hot spring water collected at a steam well and hot spring at Izu-Oshima Volcano, Japan, from the last eruptive period in 1986–1990 to the present. At the steam well, the $^3He/^4He$ ratios rapidly increased from 1.7 R_A just after the onset of the last eruptive activity in 1986 and gradually decreased after the peak value of 5.5 R_A in 1988 [4,5]. The $^3He/^4He$ ratios observed in 2016 and 2017 were 1.4 R_A, which was lower than the value before the last eruptions. The $^3He/^4He$ ratios of water and free gas samples collected at the hot spring in 2016 and 2017 were 5.2 R_A. The $^3He/^4He$ ratios corrected for air contamination were almost the same in the steam well in 1986–1998 and hot spring water in 2016–2017 (6.28 ± 0.89 R_A and 6.21 ± 0.26 R_A, respectively), suggesting that magmatic $^3He/^4He$ ratio has been almost constant for 30 years although proportion of magmatic helium in mixing with air in the steam well has almost completely diminished.

[1] Ozima & Pososek (2002), *Noble Gas Geochemistry*. [2] Padrón *et al.* (2013), *Geology*. [3] Sano *et al.* (2015), *Scientific Reports*. [4] Sano *et al.* (1995), *JVGR*. [5] Shimoike *et al.* (2000), *JVGR*.