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Noble gas geochemistry and petrology of magmatic eruption since 2022 in Ioto (Iwo-Jima) volcano, Japan

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Ioto Island (Iwo-Jima) is one of the active volcanic islands of the Izu-Bonin island arc, located about 1,250 km south of Tokyo. In July 2022, a magmatic eruption spewing pumice occurred off the coast of Okinahama in the southern part of the island for the first time in recorded history. Variations in helium isotope ratios ($^3He/^4He$) are correlated with magmatic activity, and expected to be a useful proxy for volcanic monitoring [1]. Melt inclusions, which are magma enclosed in phenocrysts, provide direct information about volatiles in magma. In this study, $^3He/^4He$ of the volcanic rocks and the volcanic gases in Ioto were compared to reveal the relationship between them. Also, major element compositions of mafic minerals, melt inclusions, and matrix glasses were measured to clarify the origin and the evolution of mafic minerals.

Minerals in the pumices were olivine, clinopyroxene, plagioclase, Fe-Ti oxide, pyrrhotite, and apatite. Some olivine and clinopyroxene were corroded, but most of them were subhedral or euhedral, and no clear zoning was observed. In addition to regular-shaped olivine, elongate-shaped olivine was found in specific pumice. Matrix glasses and melt inclusions of mafic minerals were mostly trachyte or trachydacite in composition, suggesting that the mafic minerals may have crystallized in mafic magma and been transported into trachyte magma, where they may have grown in equilibrium with it.

$^3He/^4He$ of olivines, pyroxenes were 3.3 – 7.5 and 2.0 - 4.9 Ra (where atmospheric $^3He/^4He$ of $1.4\times10^{-6} \equiv 1Ra$), respectively. Olivine with high helium isotope ratios is associated with primary magma with high helium isotope ratios (8±1 Ra)[2]. Whereas some values were lower than the volcanic gas values collected in 1997-2002, ranging from 4.7 to 5.6 Ra [3]. This indicates that minerals of the pumice may have trapped low $^3He/^4He$ magma in a trachyte magma chamber, where crustal contamination occurs. Recent inflow of primary magma may have increased the $^3He/^4He$ ratios in the magma chamber and volcanic gases, inducing the latest magmatic eruption.

[1] Padron et al., 2013, *Geology*, **41**, 539-542

[2] Hilton et al., 1993, *Geochim. Cosmochim. Acta*, **57**, 2819-2841

[3] Sumino et al., 2004, *Chemical Geology*, **209**, 143-173