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Geochemical characteristics of submarine hydrothermal plumes near Tokara Islands

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Recently a new submarine volcano has been discovered near the Tokara Islands (South of Kyushu, Japan) by a multi-beam echo sounder survey. However, only a few geochemical data are available for the investigated area. Therefore, the aim of this study is to characterize the volatile geochemistry of shallow hydrothermal system of volcano in the adjacent region of Tokara Islands. Seawater sampling was carried out by CTD-CMS hydrocasts during the RV Shinsei Maru KS-14-10 research cruise (25^{th} June – 5^{th} July, 2014) in the region stretching from Kagoshima bay to Daiichi-Amami Knoll. In the vicinity of Tokara Islands (Daiichi-Amami Knoll and Ko-Takara Shima), higher turbidity and lower pH values together with excess ^{3}He were observed at the same depth, suggesting the presence of a strong hydrothermal signal. ^{3}He and CH_4 fluxes in this region are estimated to be 0.99-2.6$\times 10^4$ atoms/cm^2/sec and 6-60 ton/year, respectively. There is a positive relationship between the excess ^{3}He and the excess ^{4}He/^{20}Ne ratio relative to the air saturated seawater value at the ambient temperature, suggesting binary mixing between atmospheric and volcanic noble gases. The end member for Wakamiko (in Kagoshima bay) samples shows subduction-type mantle He signature with about 7 R_A, while that for Tokara Islands indicates more crustal He share with a value of about 4 R_A (R_A is the atmospheric ^{3}He/^{4}He ratio of 1.382×10^{-6}). The estimated end-member of the carbon isotopic composition of CH_4 in Daiichi-Amami Knoll and Ko-Takara Shima are -29.25 ‰ PDB and -23.53 ‰ PDB, respectively. Based on the measured $\delta^{13}C_{CH4}$ values and CH_4/^{3}He ratios, it is possible to estimate the origin of methane. There show mixing between East Pacific Rise type abiogenic and thermogenic methane in Tokara Islands, while Wakamiko samples may have been fractionated through rapid microbial oxidation in the water column.

キーワード: helium, methane, flux, Tokara Islands, shallow submarine hydrothermal plumes
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