

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 (25th June – 5th 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 ³He were observed at the same depth, suggesting the presence of a strong hydrothermal signal. ³He and CH₄ fluxes in this region are estimated to be 0.99-2.6×10⁴ atoms/cm²/sec and 6-60 ton/year, respectively. There is a positive relationship between the excess ³He and the excess ⁴He/²⁰Ne 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 ³He/⁴He ratio of 1.382×10⁻⁶). The estimated end-member of the carbon isotopic composition of CH₄ in Daiichi-Amami Knoll and Ko-Takara Shima are -29.25 ‰ PDB and -23.53 ‰ PDB, respectively. Based on the measured δ¹³C_{CH₄} values and CH₄/³He 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.

Keywords: helium, methane, flux, Tokara Islands, shallow submarine hydrothermal plumes