Arsenic and mercury emission from magmatic fluid from active Iwo-yama, Kirishima volcanoes, Japan

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Phreatic eruption occurred at Iwo-yama, one of the Kirishima volcanoes in Kyushu, on the 19th April 2018. Strongly acidic saline hydrothermal fluids, of which hydrogen and oxygen isotope ratios were within that of andesite water (δ^2H= -20‰ and $\delta^{18}O$ = +5‰, so-called magmatic water), have been issuing from the two craters. The magmatic fluid contained high concentrations of As and Hg, giving a chance to observe the direct relation of these element behaviors to volcanic and the associated hydrothermal activities in an arc volcano. Here, these elements in the hydrothermal system have been traced from Jul 2018 to Dec 2019.

The endmember of hydrothermal fluid contained Cl^- and SO_4^{2-} >300 mM and its pH was <1. The highest concetration of total As was >5 mg/L, and >90 % was dissolved. The As concetration changed strongly related to the Cl^- but not SO_4^{2-} concentration. Arsenite was the primary dissolved species in the deep hydrothermal fluids, and oxidized to arsenate in the shallow part of the subsurface hydrothermal system. Monothioarsenate was synthesized in the hydrothermal pots when the arsenite was reacted with native sulfur.

Dissolved Hg was <15 % of the total Hg for the hydrothermal waters; e. g., total and dissolved Hg concentrations were 756 and 86 ppt for the hydrothermal fluid taken in Jul 2018. The maximum total Hg concentration was >4 μg/L for the water from the same location in Dec 2018 when the magma body slightly ascended. While, the maximum concentration of dissolved Hg was 0.14 μg/L in the low temperature shallow groundwater taken in Oct 2018, indicating gaseous Hg was trapped in the ambient shallow and low temperature (~15°C) groundwater.

Arsenic and Hg may be originated from dehydrtated slab components and transported int magmatic fluid, similar to Cl, then deseparated in the shallow part of the hydrothermal system.