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Gas geochemistry of the fumarolic discharges from the Tatun Volcanic Complex (Taiwan)

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The Tatun Volcanic Complex (TVC), mainly consisting of Pleistocene andesitic and pyroclastic volcanics overlying Miocene sedimentary terrains, is located in the northernmost part of Taiwan. TVC is related to the convergent boundary where the Philippine Sea plate is subducting under the Eurasian plate. This volcanic area is characterized by the Mt. Tatun and at least 20 volcanic domes. Despite its age that would suggest to consider this system as extinct, a large number of hot springs and low magnitude background seismicity occur. In this study, we present and discuss the geochemical and isotopic data acquired in the framework of a bilateral project between the Taiwanese NSC (now MoST) and the Italian CNR aimed to evaluate the equilibrium temperature of the fluid reservoir. Gas geothermometry in the H2-CO-CH4-CO_2-H_2O system based on the composition of the fumarolic discharges distributed throughout the Tatun volcanic complex are suggesting that the hydrothermal gases are strongly affected by secondary processes at shallow depth, causing a strong scattering of the concentrations of the most redox and temperature-sensitive gas species (H2, CO and CH4). Therefore, a reliable estimation of reservoir temperature using this geochemical tool is unlike. Additionally, the carbon isotopic ratios of CH4 were consistent with those typical of a shallow thermogenic source, thus masking any possible contribution of a deep fluid component. Geothermometric calculations based on the propane-propene ratios, which are affected by secondary processes at a limited extent, seem to indicate relatively high equilibrium temperatures (>300 °C) at redox conditions controlled by the volcanic gas buffer, i.e. the SO_2-H2S pair. This implies that the hydrothermal system representing the main fluid source for the fumaroles receives strong inputs of magmatic fluids, as also testified by the occurrence of SO_2 at low but significant concentrations in the surface fluids. The contribution derived by a deep source for the Tatun gases is also confirmed by the helium and carbon (in CO_2) isotopic ratios.