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Fumarolic emissions on the islands of the Macaronesia region

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Azores, Canary, Cape Verde and Madeira are the volcanic archipelagos that form the so-called Macaronesia region. Despite Madeira, all the other archipelagos have been affected by volcanic eruptions during the last 500 years and they presently show fumarolic emissions. During 2017, the gases released from the main fumarolic fields in these islands were sampled and a database with chemical and isotopic composition for the different locations was elaborated. At the Azores Archipelago, the most important fumaroles are located in the islands of São Miguel, Terceira and Graciosa, and show typical hydrothermal composition with water vapour (H_2O) and carbon dioxide (CO_2) as the most abundant gases emitted. H2S, H2, He, CO, N2, Ar, O_2 and CH4 appear as minor components. The outlet temperature ranged between 91.9 and 99.6 ºC.
Main fumarolic emissions at Canary Islands have been found out at Teide Volcano (Tenerife Island) and also show hydrothermal composition with maximum temperature around 87.7ºC. The highest temperature emission (175.3 ºC) has been measured in the fumarolic field inside the crater of Fogo Volcano (Fogo Island), at the Cape Verde Archipelago. Differently from the Azores and Canary islands, the gases emitted in this area do not contain CH4 and contain a higher amount of CO, in agreement with the higher temperatures measured here.
Isotopic compositions (3He/4He, 13C/12C) of the gas discharges can contribute to clarify the still ongoing debate about the origin of the magmatism and the source of the gases in some of the islands. The helium isotopic ratio (3He/4He) corrected for atmospheric contamination range between 5.27 (São Miguel Island) and 9.59 Ra (Terceira). In detail, the lowest ratios measured at São Miguel (5.27 – 5.38 Ra) are below the range of Mid Ocean Ridge Basalts (MORB, 8$\pm$1 Ra), indicating the addition of radiogenic 4He possibly by crustal contamination. Instead, the highest ratios measured at Terceira are above the MORB range and reflect a mantle source with a plume component. The highest 3He/4He of 7.59 and 6.72 Ra measured at Fogo and Teide fumaroles, respectively, are within or next to the MORB range. In general, our data are similar to previous studies and confirm the magmatic origin of these emissions. The carbon isotopic composition (expressed as 13CCO_2) varies between -4.66 and -2.81‰ PDB at Furnas do Enxofre (Terceira Island) and Teide (Tenerife Island) fumaroles, respectively, arguing to a deep-seated origin for the CO_2 emitted from the different fumarolic fields. Additional work is ongoing in order to improve the dataset and deepen the origin and degassing path of the emitted gases as well as to model more shallow processes that could act in modifying the pristine signature. The final goal is a comparison between different geodynamic settings.