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Preliminary results of an ongoing geochemical study at Karthala volcano, Gran Comore Island (Indian ocean)

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Grande Comore is the youngest island of the Comoros volcanic chain (western Indian Ocean) and it is located between Madagascar and East Africa. The island is constituted by two volcanoes, La Grille and Karthala, this latter recording the last eruption in 2007. Karthala volcano is the second most active volcano of the Indian ocean (after Piton de la Fournaise) and produced at least 34 eruptions since 1800 with a strong societal impact. Moreover, regional seismicity is widespread and frequent along the Comoros volcanic chain. Magmatic and active seismicity along the Comoros volcanic chain have been attributed either to the activity of a mantle plume and/or to rifting. In 2017 and 2018, we performed two geochemical surveys on Grande Comore, through fumarole gases, rock sampling and CO_2 flux measurements from soil. The two main fumarolic areas are at the volcano top (Soufrière and Choungou-Chagnoumeni). These areas occur along the main area (northern rift) of anomalous CO_2 flux on Grande Comore island. Collected fumaroles had a maximum temperature of 96°C. The fumarolic gases are CO_2-dominated. We report the first measurements of the helium (hereafter He) isotopic signature in the fumarolic gases that are up to 5.8 Ra (Ra being the He isotopic signature in air) but lower than the typical MORB range (Mid Oceanic Ridge Basalts, 8Ra$\pm$1). These values overlap those measured in olivine phenocrysts from Karthala products (from 5.1Ra to 6.3Ra; Class et al., 2005), showing that Karthala volcano is still degassing volatiles with a He isotopic signature that is in the range of those in volcanic products of the last eruption. Here we also report the first data of carbon isotope signature of CO_2 in fumarolic gases that vary from -5.0 to -3.9‰ and fall in the typical range of mantle-derived material. The diffusive CO_2 flux measurements (2017 and 2018) allowed recognizing that an active degassing occurs along the main tectonic discontinuities that cross the Karthala volcano. The highest volcanic CO_2 fluxes have been measured in the Karthala crater. Ultramafic xenoliths from the La Grille alkaline volcano have been studied with the aim at characterizing the mantle column below the Grande Comore Island. The He isotopic signature in fluid inclusions (up to 7.4Ra) in ol, opx e cpx fits well with that from literature (Class et al., 2005) and fall in a range that overlap the SCLM (Sub Continental Lithospheric mantle) and the MORB mantle signature. Here we also report the first Ne isotopes data on the fluids and enclaves of Grande Comore whose rations are indistinguishable from those of volatiles in typical MORB-type mantle reservoirs. He isotopes in volatiles from Karthala fumaroles and fluid inclusions are lower than La Grille values suggesting that a) the mantle sources feeding Karthala and La Grille volcanism are heterogeneous and/or b) additional processes modify the pristine signature of the mantle-derived volatiles emitted at Karthala volcano.

References

Class et al., 2005. Gran Comore Island: A well-constrained "low 3He/4He" mantle plume. Earth Planetary Science Letters, 233, 391-409.