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Geochemical and iron isotopic study of low-temperature hydrothermal fluids and deposits at Mayotte submarine volcanic system

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Following the seismic crisis that impacted Mayotte Island (Western Indian Ocean) since early 2018, a lithosphere-scale magmatic event resulted in the formation of a major new deep sea (~2500m) volcanic edifice, Fani Maoré, about 50 km east of the island (e.g. Feuillet et al., 2021; DOI10.1038/s41561-021-00809-x). This eruption is the largest submarine event ever documented and offers a unique opportunity to better understand the onset of water-rock interactions and associated export fluxes to the deep ocean of such extreme, yet largely overlooked event.

A total of 5 discrete ROV (Victor, Ifremer) dives were conducted during the GeoFlamme cruise (DOI 10.17600/18001297) led in April-May 2021, allowing for a comprehensive study of 3 areas: (1) The volcano summit (2559-2586m) featuring a range of hydrothermally active areas characterized by warm and diffuse fluids with temperatures up to 25°C, and Fe-rich deposits. The spatial distribution and composition of these Fe-rich deposits, displaying d^{56}Fe values up to 2.5 ‰ are consistent with a dual origin, through Fe-oxyhydroxide precipitation from the water column (i.e. plume fall-out), and/or direct precipitation from diffuse fluids, as commonly encountered in other submarine volcanoes (e.g. Loihi seamount, Rouxel et al. 2018; DOI10.1016/j.gca.2017.09.050). (2-3) The North-Western part of the volcano, including an oval volcanic dome-like structure segmented along its main axis (3224m) and a recent lava flow front (3264m), is characterized by several active venting areas (max T of 93°C) and the occurrence of extensive seafloor deposits, composed of Fe-oxyhydroxides and sulfur-rich precipitates mixed with volcanic/pyroclastic materials.

Recovered low-T fluids are variably enriched in silica, dissolved gases (CO_2, CH_4, H_2, H_2S), fluid-mobile alkali metals (K, Rb, Li), and redox-sensitive metals such as Fe and Mn, suggesting that both hydrothermal (i.e. fluid-rock interactions) and magmatic processes (i.e. degassing) are affecting fluid geochemistry. We further propose that the variable Cl- depletions in the vent fluids and silica enrichment suggest that the warm vent fluids do contain a high-temperature component at depth. While further constrains will be provided using Ge/Si, Fe/Mn and Fe-isotope systematics in the vent fluids, these preliminary results suggest an extremely rapid establishment of a mature subsurface fluid plumbing system.