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Evolution of carbon dioxide dynamics in alkaline volcanic lake Dziani Dzahav

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From May 2018 to the end of 2020, an underwater eruption gave birth to a new volcanic edifice, the Fani Maoré, 50 km east of Mayotte (Indian Ocean). Today, concerns on the volcanic activity in the area persist, and scientific community and authorities are on the lookout for signs of changes in volcanic activity.

Magmatic degassing can be observed on Petite-Terre Island of Mayotte archipelago as CO2 bubbling at the airport beach and in volcanic lake Dziani Dzaha. Since the eruption of Fani Maoré, an increase in degassing into the lake has been visually observed. This phenomenon likely attests of potential changes in the large-scale magmatic activity. We aim to quantify the degassing in the lake for a better characterization of these changes and identify future strategies for monitoring.

We present here geochemical measurements (water column chemistry, CO2 diffusive fluxes) from 2011 to 2024, covering the period before, during and after the eruption. Prior to 2020, the carbon cycle in the lake was well established and relatively stable. Between 2020 and 2022, pH of the lake went from 9.2 to 8 and CO2 diffusive fluxes at the water-air interface increased 20-fold. Most of the geochemical parameters in the lake are stable since June 2022.

Consistently with the observations of increased degassing, our findings suggest that the lake is continuously supplied by large amounts of magmatic CO2. Its pH is now controlled by [CO2]aq that itself reflects the balance between CO2 supplied to the lake and CO2 lost by diffusion at air-water interface. This allows us to estimate the quantity of CO2 dissolving in the lake as roughly 35 tons d-1. Additionally, modelling outputs suggest that the lake is highly sensitive to changes in input fluxes, and that pH and pCO2 are key parameters to follow for the monitoring of magmatic CO2 fluxes in Dziani Dzaha.

Speaker information

PhD 2nd year

Author: FRÈRE, Jonas (Institut de Physique du Globe de Paris, Paris, France)

Co-auteurs: GROLEAU, Alexis (Institut de Physique du Globe de Paris, Paris, France); JÉZÉQUEL, Didier (Institut de Physique du Globe de Paris, Paris, France, UMR CARRTEL, INRAE-USMB, Thonon, France); BÉNARD, Bhavani (Université de La Réunion, Laboratoire GéoSciences Réunion, Saint-Denis, France); ASSAYAG, Nelly (Institut de Physique du Globe de Paris, Paris, France); BARDOUX, Gérard (Institut de Physique du Globe de Paris, Paris, France); TCHIBINDA, Romaric (Institut de Physique du Globe de Paris, Paris, France); ADER, Magali (Institut de Physique du Globe de Paris, Paris, France)

Orateur: FRÈRE, Jonas (Institut de Physique du Globe de Paris, Paris, France)

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