ÉCOLE DOCTORALE
SCIENCES DE LA TERRE ET DE L'ENVIRONNEMENT
ET PHYSIQUE DE L'UNIVERS, PARIS

Subject title: Dynamics of the submarine eruption offshore Mayotte documented with very high-resolution multi-disciplinary data from the GEOFLAMME cruise

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IPGP- Marine Geoscience – UMR7154

Financing: Doctoral contract with or without teaching assignment

Presentation of the subject: (Maximum 2 pages)

An unprecedented, on-going submarine volcanic eruption is emitting significant lava volumes since mid-2018, off the island of Mayotte. This is the largest underwater active eruption ever documented. Emitted lava volumes on the seafloor exceed 6km^3 and the maximum eruptive flux was nearly 200m^{3}s^{-1}, considerable and comparable to those of the largest basaltic eruptions in Iceland or Hawaii. This eruption gave birth to a volcanic edifice more than 800 m high and 5 km in diameter (Feuillet et al., 2021, REVOSIMA).

This edifice was built in less than one year at the end of a 50-km chain that lies on the eastern insular slope of the island, and that is made by hundreds of other volcanic edifices that were formed during past eruptions, some likely of recent geological ages. These data reveal the existence of explosive cones, domes, ridges, lava flows with a very fresh morphology and typical of large basaltic eruptions as well as more evolved phonolitic compositions, both of effusive and explosive style. The area with the highest concentrations of volcanic vents and likely the largest magma production rate is located 5 to 15 km East of the Holocene explosive craters of Mayotte located on Petite-Terre and north of Grande-Terre. Morever this area (Horseshoe region) of intensive past submarine activity is currently associated with the existence of numerous active submarine fluid plumes of sedimentary, hydrothermal and/or magmatic origin that rise up to a 1000m in the water column and emit a variety of gases such as CO_2, H_2, CH_4, H_2S, He and other chemical elements presently under study. The potential causal link between the increase in the fluid plume activity, their location above the main transcrustal magmatic system, the historically known and active gas emanations on land on Petite Terre, and the current eruption down the volcanic chain, that is also linked to this magmatic plumbing system, remains the subject of activity research and hypotheses to be tested.

A rich dataset that includes geological, geophysical, and geochemical marine data has been acquired along this volcanic chain, underlain by deep magmatic reservoirs feeding the eruption. Furthermore, additionnal volcanic features (lava flows, explosive craters) are located in the so-called Horseshoe area, located 5-10 km from the coast, where most of the present-day seismicity is located. The GEOFLAMME cruise (spring 2021), onboard R/V Pourquoi Pas ?, will acquire along this volcanic chain high resolution, near-bottom bathymetry data imagery coupled with in situ observations and samples, using both an AUV and a ROV. These data, together with prior datasets (MAYOBS cruises) will be analyzed to understand the nature and architecture of the volcanic products, the relative timing of eruptive activity, the eruptive modes at several spatial scales, and their link with active faulting and fissuring. We seek to establish the chronology and constrain the dynamics of eruptive and tectonic processes based on morphology and observations, to infer the origin and mechanisms of tectonic deformation, volcanism, and the coupling of both of these processes on a lithospheric scale.

The PhD student will process and analyse the very high-resolution near-bottom AUV and ROV mapping and imaging data from the different areas of the active volcanic system (Horseshoe area and along the Mayotte Ridge). If the eruption is still in progress, the Geoflamme data will be a unique opportunity to document deep submarine eruptions processes and their interaction with the water column.

The PhD candidate will also link and integrate information and data from the wider project, including studies of fluids associated with hydrothermal activity, the distribution of gas plumes in the water column, petrological and geochemical studies, microseismicity and geodetic data, to improve our understanding of this volcanic chain and provide important new insights for the hazard evaluation of potential future credible scenarios of submarine and terrestrial eruptive activity that could have impacts on the island of Mayotte.