Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.16563

The Fe-rich, mildly alkaline magma series of Mayotte's Eastern submarine volcanic chain (Mayotte, France, Western Indian Ocean)

EMMA CHAUDRON VRIGNAUD[1], TRISTAN LACOMBE[1], ETIENNE MÉDARD[1], CAROLE BERTHOD[2], PATRICK BACHÈLERY[1], JEAN-CHRISTOPHE KOMOROWSKI[3], LUCIA GURIOLI[1], PAULINE VERDURME[1], PASCALE BESSON[3], ELODIE LEBAS[3], ISABELLE THINON[4], STEPHAN JORRY[5], FABIEN PAQUET[4], EMMANUEL RINNERT[6], NATHALIE FEUILLET[3], FOUQUET YVES[7], CÉCILE CATHALOT[6] AND ANNE LE FRIANT[3]

[1]Université Clermont Auvergne, CNRS, IRD, OPGC, Laboratoire Magmas et Volcans

[2]Observatoire Volcanologique et Sismologique de Guadeloupe, Université de Paris, Institut de Physique du Globe de Paris, UMR 7154 CNRS

[3]Université de Paris, Institut de Physique du Globe de Paris, CNRS UMR 7154

[4]Bureau de Recherche Géologiques et Minières (BRGM)

[5]Geo-Ocean UMR 6538 CNRS - Ifremer - UBO - UBS

[6]Geo-Ocean, Univ Brest, CNRS, Ifremer, UMR6538

[7]IFREMER

Presenting Author: Emma.vrignaud@etu.uca.fr

The seismic crisis that began in 2018 offshore Mayotte leading to the discovery of an active submarine volcanic chain, extending 50 km east of the island. This chain comprises two large submarine volcanic edifices, Fani Maoré in the east, where a large eruption occurred between 2018 and 2020 at 3000 m depth, and the Horseshoe 15 km of Petite-Terre island. This chain also includes numerous monogenetic cones of explosive and effusive origin and voluminous lava flows that have recently started to gain attention.

This study presents an integrated petrological and geochemical view of the whole chain. It is characterized by a bimodal weakly alkaline magmatic series. The mafic products include diversified basanites with total alkali contents between 4.5 and 8.0 wt% and SiO_2 contents ranging from 40 to 47 wt%. Felsic samples are genetically linked phonolites, belonging to different evolution stages. The Horseshoe phonolitic lava flows are the least evolved (13 wt% alkalis for 57 wt% silica) containing fayalite, magnetite and anorthoclase. We observe in the on-land phonolites of Petite-Terre and phonolitic pyroclasts from the Horseshoe an enrichment in alkalis (between 14 and 16 wt%) at constant SiO_2 content and similar mineralogical composition. Most evolved phonolites contain 17.6 wt% alkalis and are characterized by a different mineralogy with the appearance of annite mica, feldspathoids (nepheline and sodalite) and lack of fayalite. All these phonolites contain numerous xenoliths (harzburgites, quartzites and basalts) indicating that they differentiated deep within the lithospheric mantle, before ascending to the surface through sedimentary and volcanic bedrock. Intermediate compositions between basanites and phonolites are rare and have been sampled only on one submarine cone.

We present petrological and geochemical models to demonstrate that this magmatic series evolved by fractional crystallisation of basanites under low oxygen fugacity to produce phonolites in the lithospheric mantle and ultimately late stage highly differentiated phonolites near the Moho (ca. 17-20 km depth). We show that volcanism in the Horseshoe area of the chain, produced a remarkable diversity of magmas that fed abundant effusive and explosive eruptions.