Imaging, characterizing and monitoring volcanic plumbing systems of Mayotte and Montagne Pelee by combining experimental petrophysics and land/marine magnetotellurics:

P. Wawrzyniak[1]
S. Hautot[2]
P. Tarits[3]
JF. D'Eu[3]
M. Darnet[1]
B. Francois[1]
F. Gaillard[4]
F. Andujar[4]
L. Arbaret[4]
S. Warden[5]
[1] BRGM, France, p.wawrzyniak@brgm.fr
[2] IMAGIR Sarl, 29290 Saint Renan,France
[3] MAPPEM Geophysics SAS, Marine Electromagnetic Investigation, 29290 Saint-Renan, France
[4] Institut des Sciences de la Terre Orleans, CNRS-INSU/Universite Orleans/Universite de Tours, 45071, Orleans cedex 2, France
[5] Hyperion Geophysics, France

SUMMARY

Since 10 May 2018, Mayotte is experiencing one of the largest offshore seismovolcanic crisis of the 3 last centuries. The MAYOBS1 scientific mission (2-19 May 2019, Marion Dufresnes boat) discovered a 820m-high new volcanic edifice (named Fani Maore), with an estimated volume superior to 6.55 km3. Between 2018 and 2021, geophysical monitoring revealed a global eastward displacement of 21-25cm combined to a 10 to 19 cm subsidence of Mayotte, and numerous earthquakes (> 100,000) at unusual depth (22 to 45km). A combination of broadband land and marine MT surveys allowed to obtain a 30km deep 3D resistivity model of the island, unveiling two major conductive bodies at 22 and 12 km depth, with one interpreted as a volcanic mush. A new methodology, combining high pressure conductivity-temperature measurements and sensitivity study on the 3D model, achieved an estimation of the partial melt content of the mush between 25% and 40%. In addition 3 permanent MT stations are monitoring the plumbing system in the 30 first kilometers of depth with a two days time resolution. On the other side of the earth, Montagne Pelee volcano (Martinique, west indies) is experiencing since 2019 a less spectacular seismic awakening with volcano tectonic events below 10km depth and a more superficial activity in the first kilometers. In 2023 a high quality broadband MT survey allowed to obtain a 3D conductivity model of the volcano down to 20 kilometers. An off centered 11-13km depth conductive body appears to be a good candidate for a volcanic mush and will be discussed. A 9 month long, MT monitoring array demonstrator gave very promising results that will be showed.

Keywords: Volcanic plumbing systems, monitoring, petrophysics, imaging, partial melt

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