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The 2018-2019 Mayotte volcano-tectonic crisis: insights from electromagnetic experiments

M. Darnet^a, P. Wawrzyniak^a, P. Tarits^b, S. Hautot^c, J.F. D'Eu^d

p.wawrzyniak@brgm.fr

^a BRGM, Bureau des Recherches Géologiques et Minières, 3 av. Claude-Guillemin, BP 36009,
45060 Orléans Cedex 2, France

^b IUEM, Institut Universitaire Européen de la Mer, LGO, UMR 6538 - IUEM/UBO, Place Nicolas
Copernic, Plouzané, 29280, France

^c IMAGIR Sarl, Tech-Iroise, ZA de Mespaol 2, 1 rue des Ateliers, 29290 Saint Renan, France

^d MAPPEM Geophysics SAS, Marine Electromagnetic Investigation, Batiment Tech-Iroise, 1 rue des
Ateliers, Zone de Mespaol, 29290 Saint-Renan, France

Consortium REVOSIMA



MAYOTTE 2018 VOLVANO-TECTONIC CRISIS

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Facts: The May 2018 Crisis

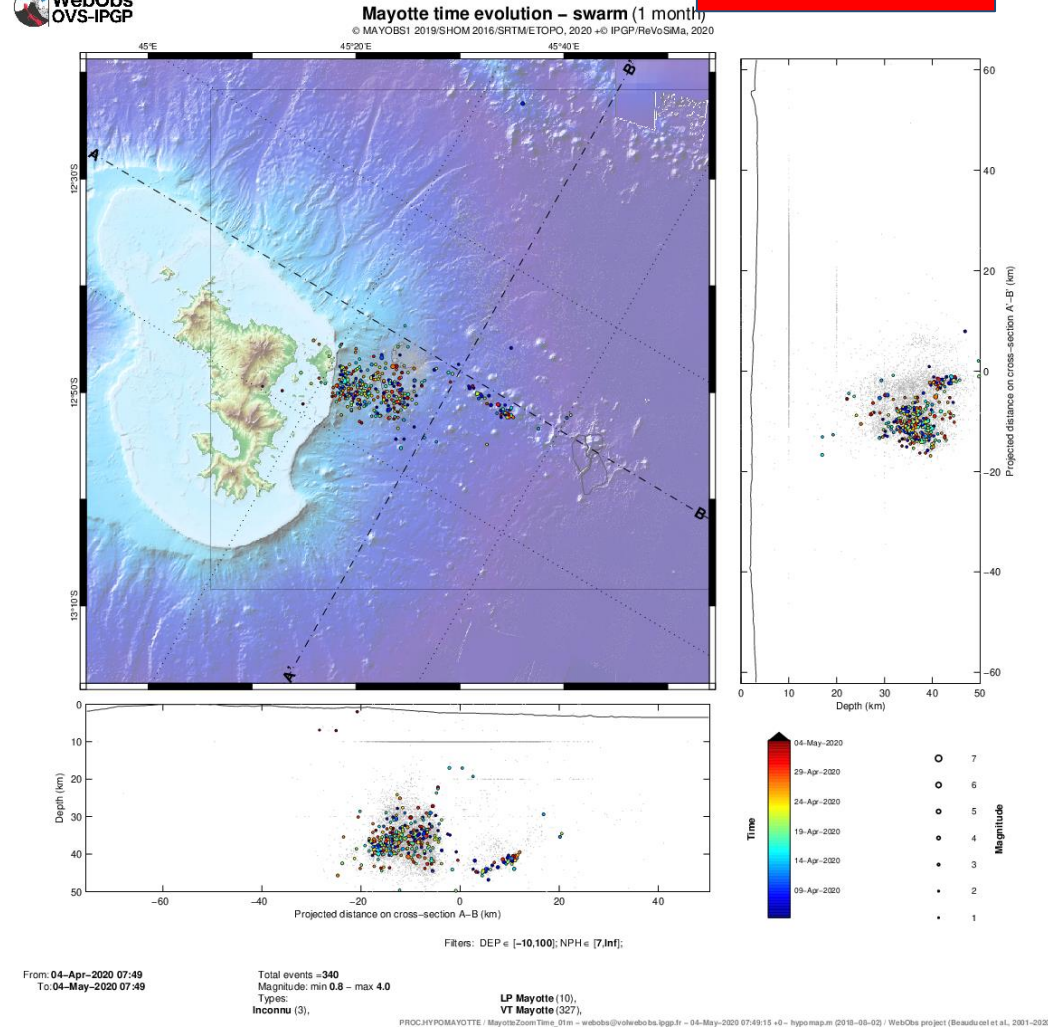
- In May 2018 a seismovolcanic crisis was initiated in Mayotte, 50km East of the Island.
- Largest seismic event ever recorded in the Comoros with a $M_w=5.9$ (Lemoine et al., 2019; Cesca et al., 2020)
- In May 2019, an estimated 5.1 km³ of lava was released from an eruptive site in the same area
- The seismicity subsequently migrated to the west and is now located between 5 and 15 km from the Petite Terre.

Uncertainty on the origin of the eruption

The possible causes of the Comoros volcanism continue to constitute a topic of controversy (Lemoine et al., 2019), as its origin could be related to

- The presence of a hot spot (Emerick and Duncan, 1982)
- Lithospheric fractures (Nougier et al., 1986)
- A combination of the two, i.e., regional extension in conjunction with asthenospheric processes (Debeuf, 2004; Michon, 2016)

→ EM Methods are sensitive to the presence of fluid at depth, ideal to detect/image possible partial melt in the crust/mantle



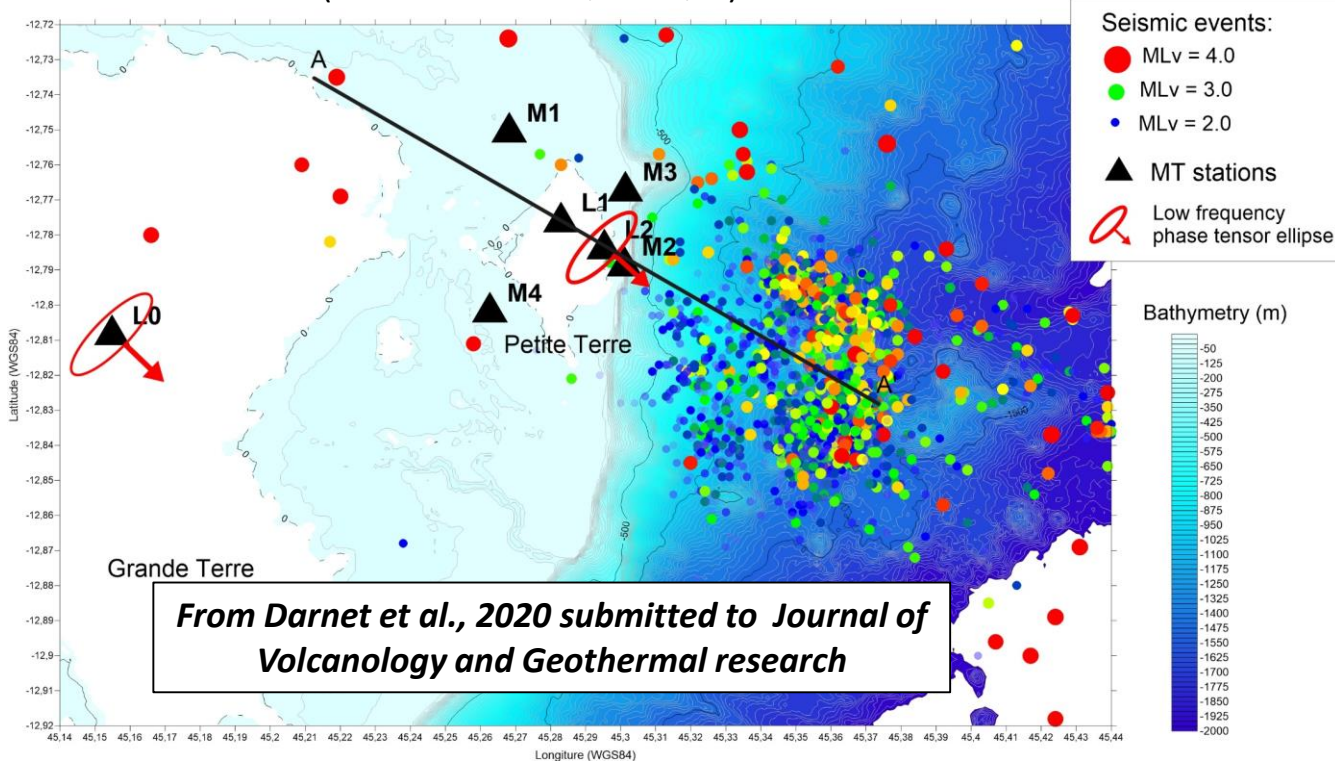
picture taken from (REVOSIMA bulletin,
<http://www.ipgp.fr/fr/actualites-reseau>).

LAND AND SHALLOW MARINE MT SETUP

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Context, Locations, Facts

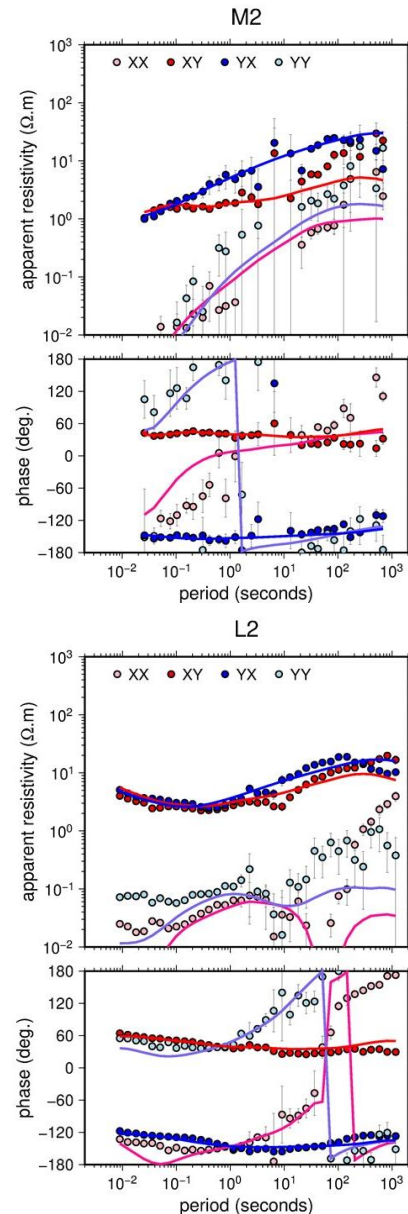
- Test survey: Initially designed to test the feasibility of combining methods for Geothermal exploration, transformed to make deep MT imaging.
- Challenging combination of land and marine systems for subsurface imaging.
- 4 Shallow Marine stations (STATEM stations, developed by MAPPEM Geophysics and the Ocean Geosciences Laboratory (LGO), European Institute for Marine Studies (IUEM))
- 2 land stations (Metronix MT stations, ADU07/08)



Phase tensor at low frequency (1mHz) are orthogonal to the direction of the oceanic ridge
→ MT detects the geo-electrical signature of a conductive structure in the direction of the ridge

MT Data

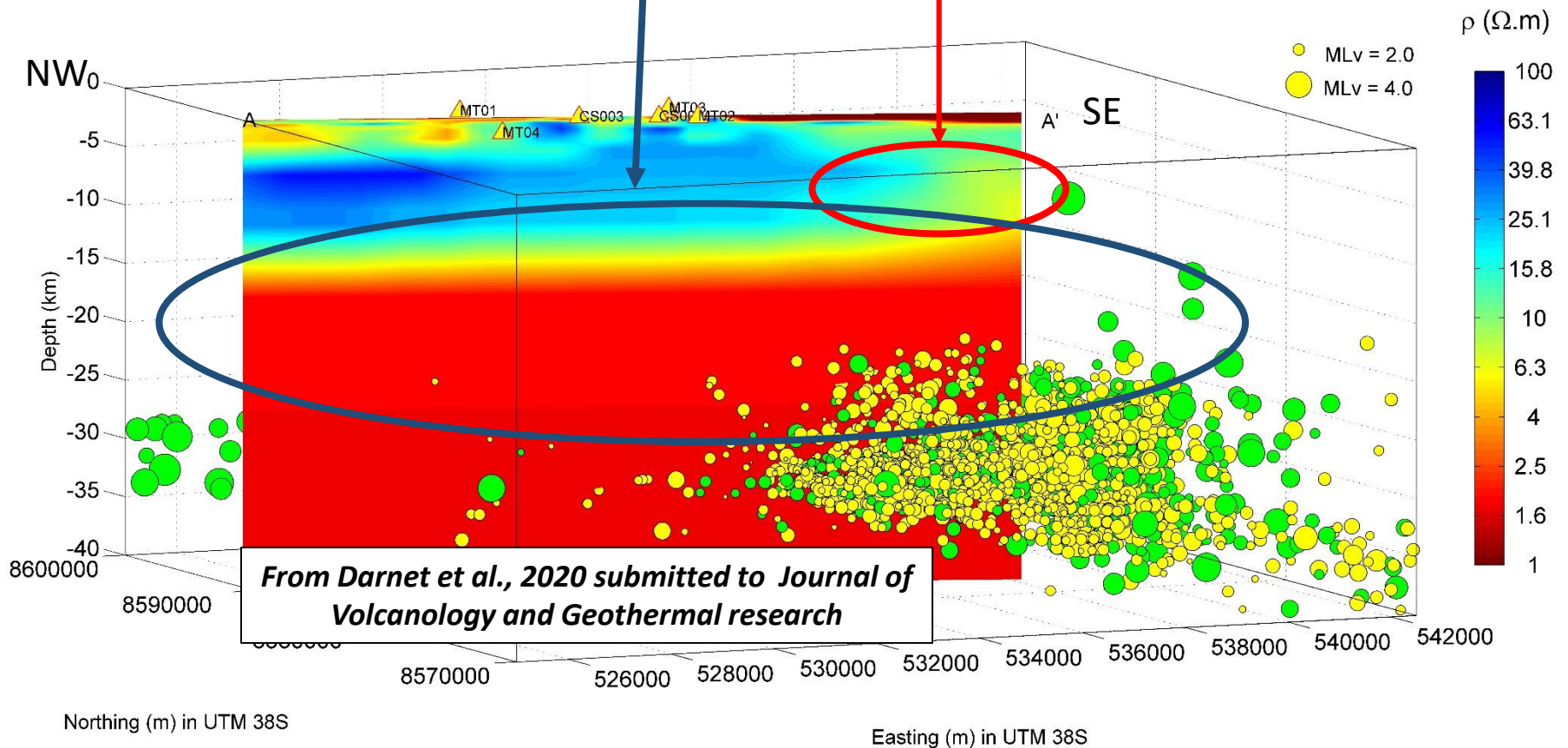
MT processing performed by IMAGIR, crosschecked by BRGM



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First clue of a deep conductive structures:

- deep conductive layer (with a resistivity of less than 2 Ohm.m) beneath a depth of 13 km
- presence of a conductor between depths of 5 and 13 km to the southeast of Petite Terre



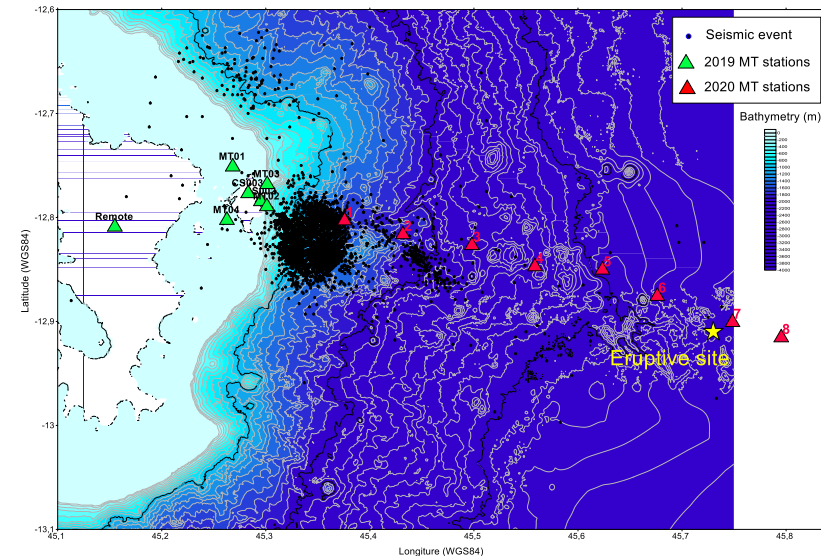
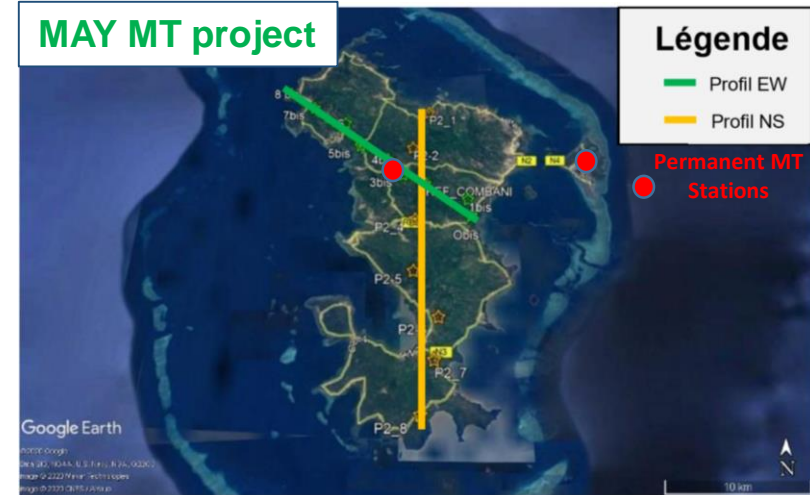
TOWARDS MORE SURVEYS

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The BRGM, MAPPEM Geophysics, the UBO and IMAGIR teamed up to initiate a first 3D imaging of Mayotte.

- A combination of Land and shallow marine MT stations allowed to:
 - detect a conductive structure in the direction of the oceanic ridge.
 - Image a deep conductive layer at ~13km depth under Petite Terre
 - Image a conductive structure on the south-east of Petite Terre between 13km depth
- Project follow ups within the REVOSIMA2:
 - Two permanent land MT stations have been monitoring the electromagnetic since May 2019. → Long term monitoring of resistivity changes at depth.
 - MT profiles will be acquired on Grande Terre (as soon as possible) → Imaging the extension of Petite Terre deep conductive anomaly under Grander Terre: **MAY MT project**
 - Marine measurements along a 60km profile are conducted by MAPPEM/UBO/BRGM → Understanding the structure of the submarine volcanic system (8 stations to be acquired)

*Results from this study have been submitted to Journal of
Volcanology and Geothermal research
under Darnet et al., 2020*



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Acknowledgments

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