



University of Genova

Department of Earth, Environmental  
and Life Sciences

Doctorate Course in Earth and  
Environmental Science and  
Technology

Università degli Studi di Genova



Dottorato in Scienze e Tecnologie  
per l'Ambiente e il Territorio

Earth Science Curriculum

Research Theme n. 2

**Titolo** *Modello geofisico e paleomagnetico dell'evoluzione e dei tassi di accrescimento del vulcano sottomarino Brothers nell'arco di Kermadec dai dati della Spedizione IODP 376.*

**Title** *Geophysical and paleomagnetic model of the evolution and growing rates of Brothers submarine volcano in the Kermadec Arc from IODP Expedition 376 data.*

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Program description including the formation program abroad:

Understanding the eruptive episodes and rates of growth of arc volcanoes is a challenging problem which has been partially investigated for few sub-aerial systems around the globe. The corresponding evolution for submarine volcanoes is virtually unknown but is expected to be significantly different from their sub-aerial counterparts due to the higher confining pressures and the different eruption dynamics. Unfortunately, we lack completely of detailed studies for submarine volcanoes, because of difficulty of access and associated lack of geophysical and geochronological data highlighting the sub-seafloor stratigraphy.

Brothers volcano in the Kermadec Arc offshore New Zealand provides a unique opportunity to tackle this fundamental problem of global significance. This volcano was targeted by the International Ocean Discovery Program (IODP) drilling Expedition 376 in 2018, where, among other data, high-resolution petrophysical, paleomagnetic and structural data were collected at selected sites on the resurgent cones and the caldera walls.

In particular, the candidate will analyze data from Site U1528, which penetrated for ~ 400 m inside the resurgent Upper Cone stratigraphically located above the southern part of the elliptical caldera, which is the main morphological structure characterizing Brothers volcano. Preliminary studies have highlighted that the rock samples here provide good paleomagnetic indicators (e.g., Caratori Tontini et al., 2023), i.e., a stable paleo-inclination can be recovered from the cores. The candidate will correlate this paleo-inclination with the Holocene master curves which are well-constrained around New Zealand, to provide accurate magnetostratigraphy and derive a corresponding chronology. These data will be analyzed in conjunction with high-resolution data acquired near the seafloor (e.g., Caratori Tontini et al., 2019), using Autonomous Underwater Vehicles (AUVs) and Remotely Operated Vehicles (ROVs). Finally, the candidate will correlate the magnetic chronology with seismic reflection data crossing the Upper Cone to identify stratigraphic horizons related to the different eruptive episodes, to understand frequency of eruptions, rate of growth, and estimate the recurrence times of caldera collapses, providing the first model of the evolution of an arc submarine volcano with results applicable to other similar systems worldwide, such as in the Southern Tyrrhenian Sea.

National/International Collaboration and overseas experience:

- Istituto Nazionale di Geofisica e Vulcanologia
- GNS Science, New Zealand
- The University of Southern Mississippi, USA
- Woods Hole Oceanographic Institution, USA

The candidate will join at least one international research cruise in 2024 around White Island/Whakaari in the Bay of Plenty offshore New Zealand, to investigate the magmatic/hydrothermal system of this submarine volcano with geophysical methods using Remotely Operated Vehicles. This trip will provide the first opportunity to visit GNS Science in Wellington, New Zealand, and collaborate with overseas partners. Two additional international cruises in the Kermadec Arc are lined-up for 2025, providing similar opportunities.

Financial support: GNS Science for cruise participation

Tutor's publications (max 3)

- 1) Caratori Tontini, F., Turner, G., Reyes, G.M., Speranza, F., Tivey, M.A., Massiot, C., de Ronde, C.E.J., Humphris, S.E. (2023). Effects of hydrothermal alteration and mineralization on the paleomagnetic properties of rocks from IODP Expedition 376 at Brothers Volcano, *Economic Geology*, doi:10.5382/econgeo.5008.
- 2) Caratori Tontini, F., Tivey, M.A., de Ronde, C.E.J., Humphris, S.E. (2019). Heat flow and near-seafloor magnetic anomalies highlight hydrothermal circulation at Brothers Volcano, Southern Kermadec Arc, New Zealand, *Geophysical Research Letters*, 46, 8252-8260.
- 3) Caratori Tontini, F., Bassett, D., de Ronde, C.E.J., Timm, C., Wysoczanski, R. (2019). Early evolution of a young back-arc basin in the Havre Trough, *Nature Geoscience*, 12, 852-862.