Geo-INQUIRE Transnational Access Project Report: CO_2 Paradox from Andrea Tonato (UGA, U.S.)

Geo-INQUIRE installation: Istituto Nazionale di Geofisica e Vulcanologia – Osservatorio Etneo, Italy (TA3-83-4)

Project title: The excess gas paradox at volcanoes: does CO_2 favor gas accumulation in mafic magmas?

Transnational access principal investigator: Andrea Tonato (University of Georgia, U.S.)

Project acronym: CO_2 Paradox

Project report ID: TA3-83-4 (3rd Call)

Transnational access team: Dra. Rossanna Corsaro (Istituto Nazionale di Geofisica e Vulcanologia – Osservatorio Etneo)

Date of visit: N/A

Geo-INQUIRE Virtual Access: N/A – Remote access to rock sample collection was requested.

Data/Products:

- Request samples from the Lithoteque of Istituto Nazionale di Geofisica e Vulcanologia.

  Samples have not been shipped yet.

Project report:

This project aims to bridge the gap between the data and analysis collected by volcano observatories and a burgeoning understanding of magma physics, particularly in the context of the key role of volatile gas species in controlling eruption behaviour. Specifically, we do not understand the controls on gas retention and release in magmas, which, in turn, influence the style, intensity, and magnitude of the volcanic eruption. A working knowledge of the controls on these disparate magma behaviours will aid in constraining the source of volcanic unrest and the style of a future eruption. Following the pilot laboratory experiments by Pistone et al. (2020) increasing CO_2 concentration in the exsolved fluid increases the isolated porosity within the magma and, therefore, favours gas accumulation in magmas prior to eruption.

The best site to conduct our project is Mt Etna (Italy), one of the best monitored and studied volcanoes in the world, characterized by frequent volcanic eruptions of different style, intensity, and magnitude. The activities of this volcano have crucial societal impacts because this is the largest active volcano in Europe with ~1 million people living under its shadow.

Therefore, the remote access to the rock samples from the INGV Lithoteque, will allow us to achieve the following goals:

- Determine magma properties preceding the volcanic eruption event through a detailed microstructural characterization, including bulk density, grain size distribution, isolated and connected porosity, crystallinity, and glass volume fraction.
- Correlate the measured magma properties with volcanic parameters such as the mass of emitted CO_2 and SO_2 gas emissions at the time of the specific volcanic eruption using ground-based measurements (permanent monitoring stations and/or ad hoc in situ measurements) at Mt Etna
- Reconstruct the pre-eruptive magma unrest dynamics leading to the eruption using existing thermodynamic models of volatile (H_2O, CO_2, and/or S) solubility and exsolution.
- Create a new database of correlated physical, chemical, and volcanic parameters along with a new workflow for sample preparation and data management throughout the project.