Report of Transnational Access Projects

(Note: the information here will be publicly disclosed in the Geo-INQUIRE website, do not include sensitive information)

Project ID: C4-TA3-83-4-1

Principal investigator: Flavia Rojas Guzmán, The University of Manchester

Project team (if applicable): Margherita Polacci, The University of Manchester

Project title: Understanding eruptive style transitions during Mt. Etna 2011-13 paroxysmal sequence: insights from vesicle texture analysis

Project acronym: VTAETNA-11-13

Hosting installation: INGV, Italy – Eastern Sicily: Lithotheque

Hosting team: Letizia Spampinato **-** Rosanna Corsaro, INGV Catania

Period of access: Remote (samples)

Report of activities:

In this project, we aim to understand the magmatic processes that generated the shifts in lava fountain intensity during the 2011-2013 Mt. Etna eruptive period. First, eruption parameters were compiled for each of the 44 paroxysms occurring between 2011 and 2013, as summarised in Calvari et al. (2018). These parameters included the duration of Strombolian activity, the duration of lava fountaining, the time-averaged discharge rate (TADR), the average and maximum fountain heights, the volume of emitted pyroclasts, and the plume type. This dataset was used to establish three intensity categories (Low, Intermediate and High) and classify each episode accordingly. This classification was shared with collaborators at INGV Catania to assess the availability of material within the Lithotheque. Based on this, a subset of six representative episodes was selected (Table 1), and pyroclastic samples were shipped to the University of Manchester, UK, for further analysis.

Geo-INQUIRE is funded by the European Commission under project number 101058518 within the HORIZON-INFRA-2021-SERV-01 call

Table 1: Characteristics of six episodes selected.

Sample	Locality of deposition	Date of eruption	Description	Intensity classification
CSE180211C	Torre del Filosofo	18 Feb 2011	Pulsating lava fountains reaching ~170 m high.	Low
CSE290811B	Base of CSE	29 Aug 2011	Pulsating lava fountains up to 100 m high.	Low
CSE240412A	Fornazzo	24 Apr 2012	Sustained lava fountaining reaching ~600 m. A plume with a heavy load of ash and lapilli produced ashfall.	Intermediate
CSE280213A	Milo	28 Feb 2013	Lava fountains reached ~500 m. Dense gas plume containing modest quantities of ash.	Intermediate
CSE230213B	Zafferana Etnea	23 Feb 2013	Lava fountains reached ~1350 m and continued for about 35 minutes. Dense plume of pyroclastic material.	High
CSE231113D	Citelli	23 Nov 2013	Lava fountains reached ~ 3000 m. Pyroclastic column several km high.	High

One clast per episode, of approximately 1 cm^3, was scanned in a HeliScan microCT at the National X-ray Computed Tomography (NXCT) facilities of The University of Manchester. The tomographic scans were conducted at 60 kV of energy and 60 µA current, achieving a voxel size of 2.9938 µm. The reconstructed 2D images were processed using the Thermo Scientific Avizo Software. Preliminary textural analysis of the six pyroclastic samples analysed is presented in Table 2. Vesicles constitute the dominant component of all analysed volumes, with volume fractions spanning from 0.60 to 0.81. However, in this early stage with only one measurement per episode, no clear relationship between vesicle volume fraction and eruption intensity can be identified. Low-intensity samples span a relatively wide range (0.67–0.78), overlapping significantly with intermediate-intensity samples (0.65–0.72). Similarly, high-intensity samples exhibit the greatest variability, with one sample showing the highest vesicle fraction of the dataset (0.81) and another the lowest (0.60). Ongoing work will expand the number of analysed samples and incorporate additional relevant vesiculation parameters, including vesicle number density, connectivity and tortuosity.

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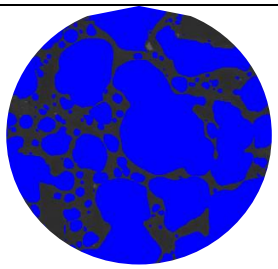
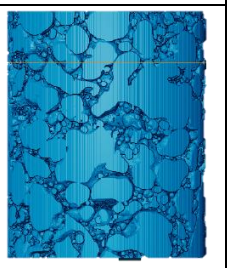
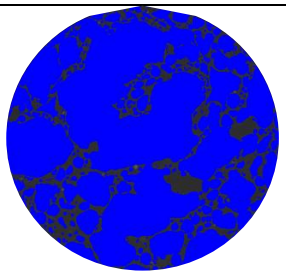
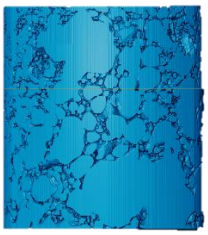
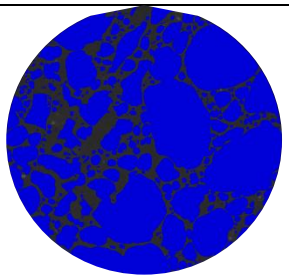
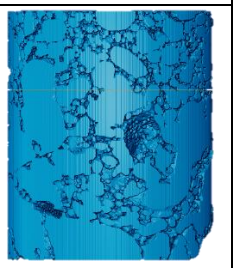
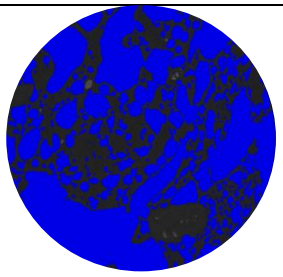
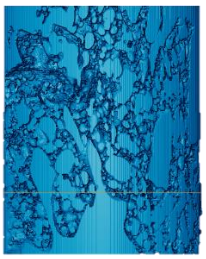
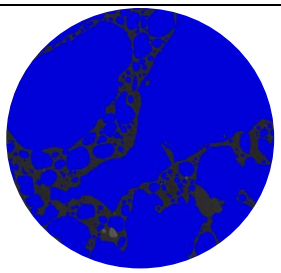
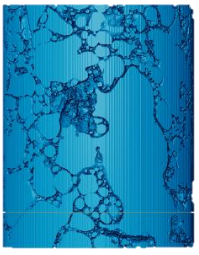
Table 2: Preliminary measurements of vesicle volume fraction, along with volume and slice views.

Sample	Total volume (mm3)	Vesicles volume (mm3)	Vesicle volume fraction	Slice (XY view)	Volume (YZ view)
CSE180211C (Low)	38.77	25.88	0.67		
CSE290811B (Low)	32.58	25.53	0.78		
CSE240412A (Intermediate)	39.86	28.54	0.72		
CSE280213A (Intermediate)	35.71	23.19	0.65		
CSE230213B (High)	38.80	31.42	0.81		

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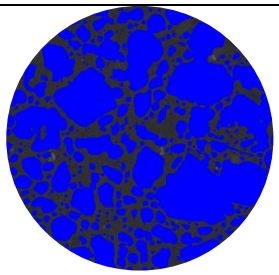
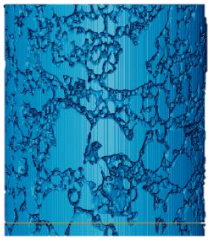
CSE231113D (High)	34.26	20.57	0.60		

Project outcomes:

Expected results from this project will provide new insights into the processes that drive shifts in lava fountain intensity at Mt. Etna and other basaltic volcanoes, with important implications for monitoring and hazard assessment in communities surrounding active volcanic centres. In addition to the analyses of vesicle morphology and connectivity from XCT data, thin sections are being prepared to study phenocryst and microlite textures using scanning electron microscopy (SEM), alongside chemical characterisation by electron microprobe analysis (EMPA). All results will be published in collaboration with INGV Catania through an open-access article.

Note: Data, products, software and publications resulting from TA activities must be publicly accessible under a CC-BY 4.0, GPLv3 or equivalent open license. No embargos beyond June 2026 are allowed. They must cite Geo-INQUIRE as the source of funding. Minimal citation: "*Geo-INQUIRE is funded by the European Union (GA 101058518)*".