**Research project on Plinian eruptions and their impact on urban environment**

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Highly explosive and low-frequency events such as Plinian and subplinian eruptions erupt cubic kilometres of magma emplaced as pyroclastic material (pumice, scoria, ash) accumulated in thick blankets around the volcanic vents. The violence of the emplacement mechanisms (e.g., fall or pyroclastic currents) and the sudden burying of the landscape make these types of eruptions extremely dangerous, and able to wipe out entire towns.
The general objective of this project is the study of the quasi-stationary dynamics of high-intensity explosive eruptions and their impact on the territory surrounding volcanoes. This objective will be pursued through the selection of a specific volcanic eruption, identified as key event for such kind of eruptive dynamics.

*The target eruption*
Plinian eruptions are relatively rare events and therefore few occurred in historical times, interacting with man-made structures. The 79 AD Vesuvius eruption represents one of the best historical examples of impact of a large explosive event on urban structures and for this reason it was chosen for this project.

*Aims*
This research will be performed applying a typical volcanological approach (stratigraphy and lithofacies definition, reconstruction of the emplacement mechanisms) in combination with chemical stratigraphy of the juvenile components (mapping out the internal petrochemical-architecture of a zoned deposit). This will allow (a) to define the sequence of the eruptive events that occurred in the different sectors around the vent; (b) to revise physical parameters of the different phases of this eruption; (c) to investigate temporal (steadiness) and spatial (uniformity) variability of the physical parameters of the pyroclastic currents; (d) to reconstruct the mobility of the pyroclastic current front (i.e., the area inundated by the current); (e) to identify changes in the dynamics of the pyroclastic currents related to the trend and distribution of the urban structures; (f) to evaluate the possible role of the feeding magma composition on the variations in the eruptive dynamics; (g) to make inferences on the causes of deaths.

*Methods*
The project is conceived as a multidisciplinary study on both fall and pyroclastic density current deposits associated to a large explosive eruption. Given the large number of possible causes generating unsteadiness and non-uniformity in Plinian eruptions, we suggest here to use a multidisciplinary approach in the study of these eruptions, in order to define the main physico-chemical parameters controlling eruption dynamics, and to quantify a possible range of these values. Stratigraphic, sedimentological (grainsize, componentry of the deposits, clast morphology), and compositional data (on whole-rock, minerals and glasses) will be used to describe the deposits of the eruptions. Mapping of the vertical and lateral compositional

variations in the deposits (both fallout and from pyroclastic density currents) will enable reconstructing the timing of magma discharge. All these data will be finally used for dedicated volcanological models to be developed in the project, aimed at deriving a physical description of the different processes acting during the eruptions and controlling/inducing variations in eruptive and transport mechanisms.

*Background*
Our research group focuses on explosive eruptions and their products. In the last 25 years we have investigated caldera formation eruptions, eruptive mechanisms of strombolian, subplinian, plinian and phreatoplinian eruptions, proximal lithic breccia deposits, and transport and emplacement processes of pyroclastic currents. One of the main areas of research was the study of the impact of explosive eruptions on urban environments. This study was carried out mainly in the archaeological sites around Vesuvius (Pompeii, Herculaneum, Stabiae and rustic villas). These researches were performed applying a typical volcanological approach in collaboration with several archaeological teams (local superintendences and academic departments) to evaluate the damages of the products of the main historical Vesuvius explosive eruptions (79, 472 and 512 AD) on the territory around the volcano.

*Social/economic impacts*
The physical understanding of the dynamics of large-intensity eruptions will enable a clearer evaluation of the expected impacts of such eruptions on anthropic structures, a key issue for improving plans for emergency management and risk reduction.
We are confident that expected results of the project will provide benchmark datasets and constitutive relationships to test and advance existing models for volcanic hazard evaluation, so that they can be confidently deployed for public safety purposes. In addition, even if conceived in a global prospective, the side-effects of this research will be a better understanding of the eruptive behaviour at Vesuvius, improving our capability to mitigate its impact on the densely populated territories that surround it.

*Output*
Results of the project will be presented at international geological, geophysical and volcanological conferences and will be published in leading international journals.

**Proposal for a PhD position**
PROJECT TITLE: **Plinian eruptions and their impact on urban environment**

Candidate Requirements: This PhD project would suit a student with a strong physical volcanology background, with a strong interest in volcanology and petrochemistry, who is keen to develop skills in field and laboratory.

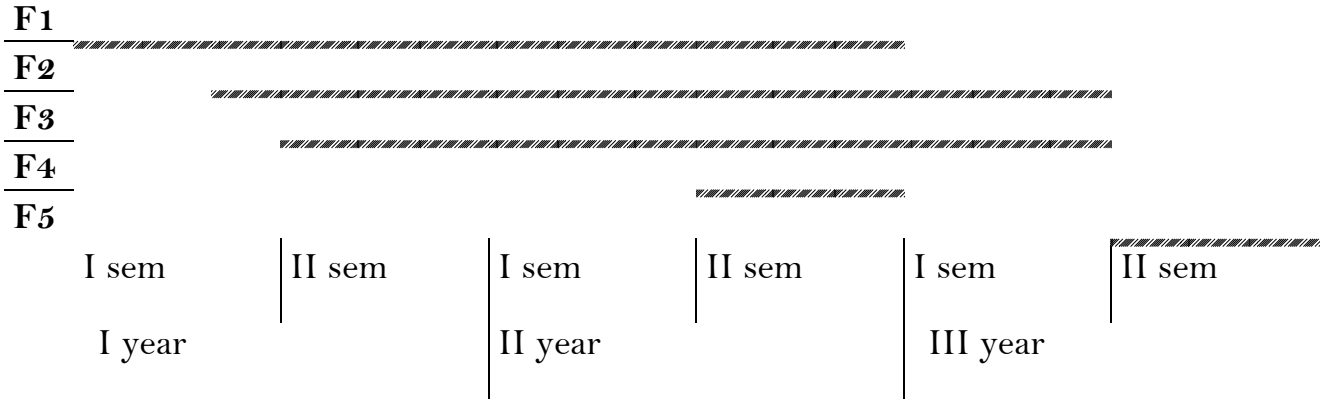
Project development:

(1) Field activity: numerous outcrops will be selected in order to reconstruct a detailed stratigraphic and facies sequence of the 79AD Vesuvius deposits, paying the utmost attention to the identification and description of the observed lithofacies, according to the distance from the eruptive centre, azimuth and topographic control, together with observations on the grain fabric;

(2) to interpret the lithofacies based on a progressive aggradation and flow boundary approach;

(3) to investigate in detail the internal petrochemical zonation of juvenile products from the 79 AD deposit, in order to tests theories on whether the leading edge of a current can advance, then retreat, during a sustained density current, and whether it can shift laterally with time;

(4) to evaluate quantitatively the damages caused by the different phases of the 79 AD eruption on building and human beings




F1 - Frequency of doctoral courses and theoretical studies
F2 - Field activities (stratigraphic analysis, facies study, sample collection)
F3 - Laboratory activities (particle size, components, petrochemical analyses)
F4 - Collaborations in Italian and/or foreign departments or research centers
F5 - Final thesis drafting

**Annexes – Supervisor responsibilities**

Scientific coordinator of the agreement between the DiSTAR and the Archaeological Park of Pompeii, which concerns the stratigraphy of outcropping volcanic successions, the evaluation of the impact and damage caused by the eruption 79 AD, the definition of a volcanological tour. Prot. N. 19 of 02.28.2018, valid for 3 years, with a renewal clause defined by article 10.

Scientific consultant for the volcanological aspects of numerous archaeological excavations in the Vesuvian area (e.g., Villa of Augustus in Somma Vesuviana; Roman baths of Pollena Trocchia; Villa Sora in Torre del Greco).