Research Networking Programmes

Short Visit Grant ☒ or Exchange Visit Grant ☐

(please tick the relevant box)

Scientific Report

Scientific report (one single document in WORD or PDF file) should be submitted online within one month of the event. It should not exceed eight A4 pages.

Proposal Title:
Study of the fragmentation mechanisms of recent Plinian eruptions in Martinique and consequences for their eruptive regimes: a combined use of field constraints and laboratory experiments.

Application Reference N°: 5649

1) Purpose of the visit

Between 29 October and 5 November 2013, a thorough field study was performed on Martinique (Lesser Antilles) as the first part of the collaborative project 5649. This project aims at constraining the dynamics of the P1, P2 and P3 eruptions, combining (i) field observations on the dispersion of the Plinian deposits and (ii) constraints on the fragmentation process based on a comparison of the grain size characteristics of natural fall units and experimentally generated pyroclasts. In total, five scientists from three institutes (Guillaume Carazzo, Edouard Kaminski, Steve Tait [all IPGP], Diego Perugini [Perugia University] and Ulrich Kueppers [LMU]) participated and contributed to an efficient campaign of deposit description and sampling (only UK was funded through MeMoVolc at this stage of the project!).

The target deposits derive from the "three most recent Plinian eruptions known as P1 (650±20 yr B.P.), P2 (1670±40 yr B.P.) and P3 (2020±140 yr B.P.)" (Roobol and Smith, 1976, 1980; Westercamp and Traineau, 1983; Traineau et al., 1989). Grain size analysis of fall units

allows for conclusions on the energy involved in magma fragmentation and ejection. Earlier studies on field and laboratory samples (Kaminski and Jaupart, 1998; Kueppers et al., 2006) had revealed differing results. As a direct consequence of in-depth discussion, the proposal for this project was written. The aim of this fieldwork was to collect 1) bulk samples from the fall units of the P1, P2 and P3 eruptions for grain size and fractal analysis and 2) juvenile samples of considerable size and porosity for laboratory-based fragmentation experiments and subsequent grain size and fractal analyses.

Comparing the grain size distribution and fractal dimension of natural fall deposits and pyroclasts generated during well-constrained experiments will tackle two fundamental questions: 1) What is the influence of transport-related sorting and/or secondary fragmentation on the different results found by Kaminski and Jaupart (1998) and Kueppers et al. (2006)? and 2) Can we constrain the fragmentation energy of the P1, P2 and P3 eruptions of Mount Pelée volcano and take the result into account when modelling the eruptive scenarios? The answers to both questions are fundamental to our mechanistic understanding of Plinian eruptions and the related hazards, not limited to but especially in the Lesser Antilles.

2) Description of the work carried out during the visit

Based on the IPGP colleagues' thorough knowledge of the field relationships by the , all three target deposits have been described and sampled at various locations. Due to relatively efficient fragmentation during Plinian episodes, as shown by grain size analysis of the coarse fraction of the fall units performed at the volcano observatory, these fall units were too fine grained (commonly < 5-10 cm) for laboratory fragmentation experiments. In order to allow for collecting samples large enough for fragmentation experiments we sampled juvenile clasts of up to > 50 cm in diameter from the deposits of pyroclastic density currents of each eruption, assuming that the physical properties of the involved magma didn’t differ significantly throughout the course of these eruptions.

3) Description of the main results obtained

Approx. 100 kg of samples have been shipped back to LMU and are currently processed in Munich and prepared for fragmentation experiments (drilling, cylinder trimming, weighing, measuring porosity and crystal content).

4) Future collaboration with host institution (if applicable)

As proposed and accepted for funding, one colleague from IPGP will come to Munich for one week to attend some of the experiments to be performed.

5) **Projected publications / articles resulting or to result from the grant *(ESF must be acknowledged in publications resulting from the grantee's work in relation with the grant)***

After the end of the experiments, the results will be discussed between all five colleagues and a common publication is planned.

6) Other comments (if any)

We are thankful for the support of the Observatoire Volcanologique et Sismologique de la Montagne Pelée (IPGP) that hosted the mission.