Subject offered for a contract starting october 2017

SUBJECT TITTLE: The key role of two-phase flows (gas and viscous magma) in driving eruptions. Insights from fluid mechanics laboratory experiments and the analysis of long-time series of infrasonic-seismic records at Erebus volcano (Antartica

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Host lab/ Team: **IPGP- Dynamique des Fluides Geologiques**

Financing: Doctoral contract with or without assignment

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Presentation of the subject: (1 or 2 pages)

The crucial role of the gas, in driving volcanic eruptions at depth and at surface, is now widely recognised. The viscous magma is displaced by the nearby bubbles (diameter from microns to several meters) in various ways (2-phase flows), depending on the type of volcanic activity, i.e. explosive, effusive or persistent at open-vents.

Open-vents volcanoes, often presenting series of Strombolian explosions of various intensities, i.e. a quasi-regular series of large Taylor bubbles breaking at the surface, are responding, although with a delay, to any changes in the degassing pattern within a shallow magma reservoir. Hence, they are providing a quasi-direct route to phenomena occuring at depth, where eruptions are initiated. Open-vents volcanoes display a persistent volcanic activity, although of variable intensity. Their phases of enhanced activity could therefore be interpreted as analogous to eruptive phases of a volcano alternating between eruptions and quiescence periods. Long-times series at open-vents volcanoes could therefore be key measurements to unravel physical processes at the origin of eruptions and be crucial for monitoring. For example, continuous infrasonic records (sound waves <20 Hz) can be used to estimate the gas volume expelled at the vent, both during explosions and between explosions, but also at depth, providing the use of a model of 2-phase flows patterns in conduit and reservoir. Additional key informations can be obtained from performing laboratory experiments in fluid mechanics, in which the key physical features of some eruptive patterns can be reproduced and modelled.

The first aspect of this phD will consist in analysing the long-time series of infrasonic and seismic signals recorded close to Erebus volcano (Antartica), using existing automatic codes. These records will be interpreted to understand the temporal evolution of the eruptive activity (gas volume and strength of explosions) and the changes in degassing patterns.

The second aspect of this phD will use the experimental facilities of the fluid mechanics laboratory to mimic 2-phase flows (bubbles in viscous fluids) in an analog volcano. The formation of bubble clusters, produced by a foam accumulated at the top of a large reservoir and spreading into a small uppermost conduit (an initial condition most analogous to eruptive conditions) and their coalescence in the conduit will be characterised and modelled. Finding the conditions for the transitions between the various regimes and the characteristic diameter of bubble clusters will be a key to understand the eruptive patterns and their changes.