AEOLUS: a laboratory to study bubble-bearing flow dynamics and geophysical signals through analogue volcanic eruption

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Basaltic volcanoes represent a very large portion of active volcanism and exhibit a wide variability in their eruptive style. The basaltic eruptive activity in fact shows either a purely effusive behavior or an explosive character, which can, rarely, also turn into violent Plinian eruptions. The most characteristic explosive activities of basaltic magmatism are represented by Strombolian eruptions and lava fountains. The study of the relationship that exists between the pre-eruptive dynamics (e.g. fractional crystallization, mixing, degassing), the chemical-physical variations of the magma in the volcanic feeding system and the related outcomes (in terms of eruptive style and geophysical markers) at the surface has been, in the last decades, reason of numerous studies. Nonetheless, the complexity of the volcanic system and its inaccessibility to direct observations still makes it difficult to reconstruct the dynamics of the magmatic system, basing on surface observations of the eruptive activity. A challenging objective of modern volcanology is to quantitatively characterize eruptive/degassing regimes from geophysical signals (in particular seismic and infrasonic), for both research and monitoring purposes. The outcomes of the attempts made so far are still considered very uncertain because volcanoes remain inaccessible when deriving quantitative information on crucial parameters such as plumbing system geometry and magma viscosity. Therefore the realization of laboratory made by several devices, capable to scale and reproduce in a controlled way the degassing dynamics of volcanic systems and measure the relative elastic markers (seismic and acoustic), is an indispensable tool to identify reliable quantitative relationships between the geophysical signals and the related eruptive and outgassing parameters. With the Aeolus project we build an experimental laboratory for the study of degassing dynamics through analogue volcanic eruptions. In particular the laboratory is capable of 1) investigate the relationship between degassing processes and the relative seismo-acoustic signals; 2) study the effect of different degrees of irregularity (i.e. roughness of the internal surface) of volcanic conduits on the eruptive style and/or the associated seismic-acoustic signals; 3) unravel the timescales of cyclic activity at basaltic volcanoes, reproducing the foam collapse model of Jaupart and Vergniolle (1988, 1989), which explains the transition between different explosive terms of the basaltic system (e.g. Strombolian activity and lava fountains), in a range of dimensionless parameters close to the volcanic system.