Geophysical Research Abstracts
Vol. 16, EGU2014-12959-2, 2014
EGU General Assembly 2014

Pyroclast acceleration and energy partitioning in fake explosive eruptions

Damien Gaudin (1), Jacopo Taddeucci (1), Bettina Scheu (2), Greg Valentine (3), Antonio Capponi (1,4), Ulrich Kueppers (2), Allison Graettiger (3), and Ingo Sonder (3)

(1) HP-HT Lab, Istituto Nazionaledi Geofisica e Vulcanologia, Rome, Italy, (2) Ludwig-Maximilians-Universität (LMU), Munich, Germany, (3) University at Buffalo, United States, (4) Lancaster Environment Centre, Lancaster University, UK

Explosive eruptions are characterized by the fast release of energy, with gas expansion playing a lead role. An excess of pressure may be generated either by the exsolution and accumulation of volatiles (e.g., vulcanian and strombolian explosions) or by in situ vaporization of water (e.g., phreato-magmatic explosions). The release of pressurized gas ejects magma and country rock pyroclasts at velocities that can reach several hundred of meters per second.

The amount and velocity of pyroclasts is determined not only by the total released energy, but also by the system-specific dynamics of the energy transfer from gas to pyroclasts. In this context, analogue experiments are crucial, since the amount of available energy is determined. Here, we analyze three different experiments, designed to reproduce different aspects of explosive volcanism, focusing on the acceleration phase of the pyroclasts, in order to compare how the potential energy is transferred to the pyroclasts in different systems.

In the first, shock-tube-type experiment, salt crystals resting in a pressurized Plexiglas cylinder are accelerated when a diaphragm set is suddenly opened, releasing the gas. In the second experiment, a pressurized air bubble is released in a water-filled Plexiglas pipe; diaphragm opening causes sudden expansion and bursting of the bubble and ejection of water droplets. In the last experiment, specifically focusing on phreatomagmatic eruptions, buried explosive charges accelerate the overlying loose material. All experiments were monitored by multiple high speed cameras and a variety of sensors.

Despite the largely differing settings and processes, particle ejection velocity above the vent from the three experiments share a non-linear decay over time. Fitting this decay allows to estimate a characteristic depth that is related to the specific acceleration processes. Given that the initial available energy is experimentally controlled a priori, the information on the acceleration processes (and related kinetic energy) can be used to brings new constraints on the energy partition and general pyroclasts ejection mechanisms during eruptions.