Geophysical Research Abstracts
Vol. 15, EGU2013-6784, 2013
EGU General Assembly 2013

Eruptions on the fast track: application of Particle Tracking Velocimetry algorithms to visual and thermal high-speed videos of Strombolian explosions

Damien Gaudin (1), Moroni Monica (2), Taddeucci Jacopo (1), Shindler Luca (2), and Scarlato Piergiorgio (1)

(1) Department of Seismology and Tectonophysics, HP-HT lab, Istituto Nazionale di Geofisica e Vulcanologia. Rome, Italy.,
(2) DICEA, Sapienza University of Rome. Rome, Italy

Strombolian eruptions are characterized by mild, frequent explosions that eject gas and ash- to bomb-sized pyroclasts into the atmosphere. Studying these explosions is crucial, both for direct hazard assessment and for understanding eruption dynamics. Conventional thermal and optical imaging already allows characterizing several eruptive processes, but the quantification of key parameters linked to magma properties and conduit processes requires acquiring images at higher frequency. For example, high speed imaging already demonstrated how the size and the pressure of the gas bubble are linked to the decay of the ejection velocity of the particles, and the origin of the bombs, either fresh or recycled material, could be linked to their thermal evolution.
However, the manual processing of the images is time consuming. Consequently, it does not allows neither the routine monitoring nor averaged statistics, since only a few relevant particles – usually the fastest – of a few explosions can be taken into account.
In order to understand the dynamics of strombolian eruption, and particularly their cyclic behavior, the quantification of the total mass, heat and energy discharge are a crucial point. In this study, we use a Particle Tracking Velocimetry (PTV) algorithm jointly to traditional images processing to automatically extract the above parameters from visible and thermal high-speed videos of individual Strombolian explosions. PTV is an analysis technique where each single particle is detected and tracked during a series of images. Velocity, acceleration, and temperature can then be deduced and time averaged to get an extensive overview of each explosion. The suitability of PTV and its potential limitations in term of detection and representativity is investigated in various explosions of Stromboli (Italy), Yasur (Vanuatu) and Fuego (Guatemala) volcanoes.
On most event, multiple sub-explosion are visible. In each sub-explosion, trends are noticeable : (1) the ejection velocity decreases with time, which is compatible with the models of bubble explosions (2) the mean size of the particles tend to decrease, showing a higher fragmentation at the beginning of the sub-explosion and (3) the ejection angle can slightly vary. The number of sub-explosions and the characteristics of trends can provide new physical constraints such as the depth of the explosion or the diameter of the gas bubble that burst.