TITLE: Experiments on aggregation of volcanic particles

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Context

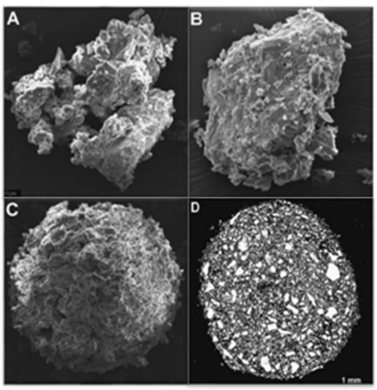
The large amount of fine ash released in the atmosphere by explosive volcanic eruptions constitutes a serious hazard to infrastructures, various economic and transport sectors (e.g. aviation), and to both human and animal health. Since most of the fine ash sediments in the form of aggregates, which commonly fall considerably faster than single particles, a quantitative understanding of aggregation mechanisms is of primary importance for an accurate estimation of ash concentration over time and space. In order improve our understanding, we need to predict the probability that two particles will collide (collision efficiency) and, in case they collide, the probability that they will stick (sticking efficiency). Both efficiencies depend on a large number of variables (temperature, humidity, turbulence intensity, electrical charge of the particles, collision velocity, size of the particles, etc.).

Objectives and Methods

We will carry out dedicated experiments to quantify the role played by different variables on the sticking efficiency. In particular, several particles will be released in a settling column towards a glass plate. By filming the particle-plate collisions with a high speed camera, the velocity of the particle will be measured just before and just after the impact with the plate. From the decrease in velocity, it is possible to calculate the energy dissipated by the collision, which is directly related to the sticking efficiency. By repeating the experiments with both silica beads and volcanic particles, and with both a glass plate and an ash substrate, it will be possible to quantify how the sticking efficiency is affected by the size, material, velocity, shape and charge of the colliding particles. Besides being an important step towards a quantitative understanding of volcanic aggregation mechanisms, which is necessary to accurately forecast ash dispersal, this experiment will be also useful in other fields, such as astrophysics, meteorology, pharmaceutical chemistry, mechanical engineering, where aggregation of irregular particles is important.

Literature

- *Brown R, Bonadonna C., Durant A., (2011) A review of volcanic ash aggregation, Physics and Chemistry of the Earth (http://www.sciencedirect.com/science/article/pii/S1474706511003172)*
- *Rose, W. I. & Durant, A. J. (2011) Fate of volcanic ash: aggregation and fallout. Geology 39, 895–896.*
- *Taddeucci J., Scarlato P., Montanaro C., Cimarelli C., Del Bello E., Freda C.D. (2011) Aggregation-dominated ash settling from the Eyjafjallajökull volcanic cloud illuminated by field and laboratory high-speed imaging: Geology, v. 39, p. 891–894.*



Scanning Electron Microscope images of aggregates of volcanic ash

Sites WEB

http://cms.unige.ch/sciences/terre/research/Groups/physical_volcanology/physical%20volcanology.php

Choice of orientation :

Geological Risks