ECOLE LEMANIQUE DES SCIENCES DE LA TERRE
DES UNIVERSITES DE GENEVE ET DE LAUSANNE

Master of Sciences in geology

TITLE: Can candy-cotton shed new light into volcanic particle aggregation?

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Context

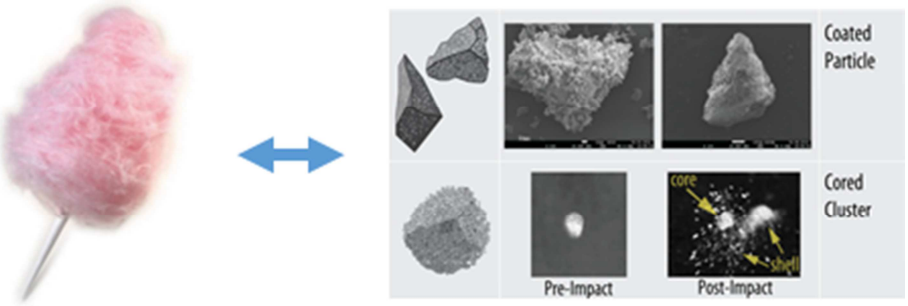
The large amount of fine ash released in the atmosphere by explosive volcanic eruptions constitutes a serious hazard to infrastructures, various economic and transport sectors (e.g. aviation), and to both human and animal health. Since most of the fine ash sediments in the form of aggregates, which commonly 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

An experiment will be performed to estimate the growth rate of volcanic aggregates, with a focus on coated particles and cored clusters [1]. A particle of about 100 µm will be fixed on a rotating support. The rotating particle will be immersed in a jet of micron-sized particles, whose velocity and size are small enough for sticking to occur. During the process, the aggregate will grow similarly to what happen during the making of a candy-cotton. Filming the growing with a high speed camera, the variation of aggregate's diameter over time will be estimated. Even though it does not represent a perfect reproduction of the natural aggregation process (in which the aggregate is not constrained by any support, and the collision efficiency is not constant through time), this experiment will shed some light into fundamental mechanisms that come into play. In particular, a quantification of the aggregation rate over time will allow the quantification for the first time the role played by the "fluffiness" of the aggregate on energy absorption. This factor, which might be crucial for aggregate formation, is disregarded in currently used aggregation models [2]. The experiment will be repeated fixing an ice grain instead of a volcanic particle, to quantify the increase in sticking efficiency due to the presence of ice [3].

Literature

[1] Bagheri, Rossi, Biass, Bonadonna (2016), Timing and nature of volcanic particle clusters based on field and numerical investigations, Journal of Volcanology and Geothermal Research
[2] Brown R, Bonadonna C., Durant A., (2012) A review of volcanic ash aggregation, Physics and Chemistry of the Earth
[3] Durant A. J., et al. (2008), Ice nucleation and overseeding of ice in volcanic clouds, J. of Geoph. Research



Scanning Electron Microscope images of aggregates of volcanic ash (from Bagheri et al. 2016)

Sites WEB

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

Choice of orientation :

Geological Risks