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# Electrification of experimental volcanic jets and their controlling parameters.

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Plume electrification and generation of spectacular lightning display are common feature of ash-generating explosive eruptions. As demonstrated by several recent occurrences (Bogoslof 2017, Ambae 2018, Fuego 2018, Krakatau 2018), volcanic lightning can be used for determining the occurrence and location of ash plumes. However, the applicability of this technique as an operational monitoring system is still limited by the lack of quantitative relationships between the eruption parameters and the occurrence and intensity of flashes. We approach this problem by reproducing charging and electrical discharges in particle-laden jet flows using rapid decompression experiments. We use three shock tubes of different diameters (20, 26 and 33 mm) to pressurize (2 to 20 MPa initial pressure) a variable mass (20 to 60 g) of ash, with variable proportions (0 to 15 wt%) of fine material (i.e. Stokes number <1). The flow is accelerated in a Faraday cage, which records the net electric charges escaping the shock tube, and the number and magnitude of the produced flashes. We use this setup to study the effect of three main parameters, recognized as crucial for the generation of volcanic lightning: 1) the mass of ejected particles (eruption magnitude), 2) the initial pressure inside the shock-tube and that in the jet (eruption intensity) and 3) the amount of fine particles (grain size distribution). Rusults show that pressure, ejected solid mass and proportion of fines all contribute to increase the total magnitude of discharges, although in different ways: while the proportion of fine particles positively correlates with the total number of flashes, the initial pressure and the ejected mass positively correlate with the magnitude of individual discharges. In addition to the magnitude of the discharges, also their time of occurrence from the onset of the explosion and their magnitude distribution in time can be used to derive complementary information on the plume characteristics. Important analogies can be derived from our experiments with respect to the natural occurrence of volcanic lightning, suggesting that electric monitoring of explosive eruptions can provide complementary information not only on the occurrence of volcanic plumes but also on their dynamics.