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Triboelectric charging of volcanic ash from Grímsvötn

Isobel Houghton (1), Karen Aplin (2), and Keri Nicoll (3)

(1) Department of Electrical and Electronic Engineering, University of Bristol, Bristol, United Kingdom (isobel.houghton@bristol.ac.uk), (2) Department of Physics, University of Oxford, Oxford, United Kingdom (k.aplin1@physics.ox.ac.uk), (3) Department of Meteorology, University of Reading, Reading, United Kingdom (k.a.nicoll@reading.ac.uk)

Volcanic ash is known to charge electrically, producing some of the most spectacular displays of lightning in nature. Triboelectric charging is one mechanism associated with volcanic plume electrification. Previous theoretical work on triboelectric charging of single-material particle systems has shown that the charging is likely to be determined by the number size distribution (Lacks and Levandovsky, 2007).

Here we investigate triboelectric charging of a sample of ash from the Grímsvötn eruption in 2011 using a specially designed apparatus. Ash is released to fall under gravity through a screened metal cylinder and into an isolated Faraday cup. A sensitive electrometer is used to measure the voltage change associated with the charge on the ash. The release mechanism has been designed to facilitate only self-charging of the ash, as is expected in the atmospheric plume.

Using geological sieves to separate the sample into different size fractions, we were able to create artificial size distributions to investigate the effects of changing the number size distribution. We find that for a sample with a narrow range of particle sizes, the Faraday cup voltage change is much smaller than for a sample with a wide range of particle sizes, in agreement with theory. These results demonstrate that self-charging of ash through triboelectrification is likely, supporting both a frictional origin for the sustained lightning observed during the Grímsvötn eruption, and other observations of self-charging in a plume distant from the source.