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Electrical charging of volcanic ash from Eyjafjallajökull

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Electrical charging of volcanic ash is important for both the generation of lightning and the detectability and lifetime of volcanic plumes, but remains poorly understood. Previous work showed that volcanic ash samples obtained from the 2011 Grímsvötn eruption were readily electrically charged by friction, a process known as contact charging or triboelectrification. The efficiency of charging depended on the span, or width, of the particle size distribution, with broader charge distributions charging more than narrower or more multimodal distributions. Here we report results of laboratory experiments investigating the charging of ash from Eyjafjallajökull, using samples collected from Solheimaheiþi, 22km from the crater, on 5 May 2010. A similar methodology to the earlier experiments with Grímsvötn ash was used, which involved letting small quantities of ash fall through a charge collection apparatus, and measuring the charge with a sensitive electrometer. The ash was sieved into different size bins, and artificial size distributions were also created to investigate the effect of the modality and span of the samples tested.

Like the ash from Grímsvötn, the Eyjafjallajökull ash charged more effectively when the size distribution was broader. Ash from Grímsvötn charged more readily, and with an opposite sign, than Eyjafjallajökull ash, with a median net charge of +630 pC/g compared to -116 pC/g. This difference in charging is not completely explained by the span effect described above, since the two unsieved ash samples had very similar overall spans, so would have been expected to have similar median net charges. We find that the charging may also be affected by the role of the smallest particles, <45 μm, which generate a negative, then positive, charge as they fall through the apparatus, whereas the samples containing larger particles only contained one sign of charge. There are expected to be two charging mechanisms involved: (1) frictional charging across different materials within the ash sample, similar to the well-known "triboelectric series", which depends on the chemical composition of the ash sample; and (2) similar materials of different sizes transferring electrons from larger to smaller particles.