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Surface area and volume measurements of volcanic ash particles using micro-computed tomography (micro-CT): A comparison with scanning electron microscope (SEM) stereoscopic imaging and Brunauer-Emmett-Teller (BET) model

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Volcanic ash particles are important components of explosive eruptions and their surface texture is the subject of intense research. Characterization of ash surfaces is crucial for understanding the physics of the volcanic plumes, remote sensing measurements of ash and aerosols, interfacial processes, modelling transportation and deposition of tephra and characterizing eruptive styles. A number of different methods have been used over the years to arrive at surface area estimates. The more common methods include estimates based on the geometric considerations (geometric surface area) and the physisorption of gas molecules on the surface of interest (physical surface area). In this study, micro computed tomography (micro-CT), a non-destructive method providing three-dimensional data enabled the measurement of surface areas and volumes of individual ash particles. Specific surface area estimates for ash particles were also obtained using nitrogen as gas adsorbent and the BET (Brunauer-Emmett-Teller) model. Results were compared with the values obtained from SEM stereoscopic imaging and geometric considerations. Surface area estimates of micro-CT and SEM stereoscopic imaging overlaps with mean specific surface area results of 0.0167 and 0.0214 m2/g, respectively. However, ash particle surface textures present quite a deviation from that of their geometric forms and approximation to sphere and ellipsoid both seemed to be inadequate for representation of real ash surfaces. The higher surface area estimate (> 0.4 m2/g) obtained from the technique based on physical sorption of gases (BET model here) was attributed to its capability for surface areas associated even with angstrom-sized pores. SEM stereoscopic and/or micro-CT imaging were suggested for characterization of textures on macro-pore regions of ash particles.