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Shape evolution of pyroclasts in tumbling experiments

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During explosive volcanic eruptions involving felsic magmas, angular porous pyroclasts are generated and ejected into the atmosphere. As these pyroclasts are mechanically weak, transport processes after fragmentation can alter their shape. Rotary tumbling experiments have been used to mimic particle-particle interaction during Pyroclastic Density Currents (PDC) or sedimentation and to understand the role of transport mechanisms on fine ash generation and changes in pyroclast morphology. We used clasts generated by Hornby et al. (2020) to statistically quantify the shape evolution of pre- and post-tumbling pyroclasts. Two types of Laacher See pumice were used as starting material. *LSB* (Laacher See Bims*)* was industrially processed by ROTEC® by wet sieving, while *ULST* (Upper Laacher See Tephra) represents pristine clasts from fall units of the Laacher See eruption. Four sets of tumbling experiments (T1, T2, T3A, T3B) were performed. All lasted in total 120 minutes and ash generation was quantified after 15, 30, 45, 60 and 120th minutes. In T1 experiments, ash generated was added back into the drum after each increment but left out and stored separately in T2 experiments. In T3 steel balls were added to the drum to simulate the impact of lithics on the mechanical response of pumice lapilli. All other boundary conditions of T3A experiments mimic those of T1 while T3B experiments mimic T2. We quantified three values for each set of clasts: 1) amount of ash generated (dry sieving), 2) clast volumes (following Pisello et al., 2023), and 3) clast morphology. For the latter, we used shadowgraphs of 100 clasts per sample set independently, processed the images on Photoshop (clast contours delimitation and binarization) and calculated shape parameters (Convexity, Solidity, Form factor and Axial ratio, see Liu et al., 2015) using ImageJ. As expected, a striking distinction between starting material and tumbled clasts was found. We present data for 1) ash generation efficiency (≤ 53%), 2) clast volume (reduction), and 3) shape parameters (≤ 0.15 increase) to evidence the importance of pyroclast overprinting during transport-related processes. As clasts collected from fall units (see ULST here or Pisello et al., 2023) are angular, particle-particle interaction during gas-pyroclast flow inside conduits is found to have been of minor importance.