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Experimental simulations of the physical weathering of a rhyolitic glaciovolcanic glass

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Hyaloclastites are a common eruption product formed during subglacial eruptions. These glassy materials are often found in periglacial environments and they are highly abundant in the environments in Iceland and on planet Mars. Physical weathering results therefore primarily from freeze-thaw cycles and abrasion during aeolian transport. We studied various facets of the mechanical modification of these materials using a fresh rhyolitic hyaloclastite from the Bláhnúkur edifice in Torfajökull (Iceland). Experiments were set up to simulate the environmental conditions during freeze-thaw cycles. Physico-mechanical properties were measured for understanding scale effects from freezing of water inside pores and tensile strengths from volumetric expansion of ice. Fracturing was found to occur primarily by crystallisation inside larger vesicles and interparticle pore spaces, whereas surface pores only marginally contributed to superficial crack propagation. Experimental simulations of aeolian abrasion consisted of tumbling sand-sized particles for 15 weeks (equivalent to transport distances of >500 km) in rotating drums. Compared to the effects of ice-induced weathering, abrasion only leads to marginal textural alterations. Larger, centimetre-sized components in glassy breccias are therefore considered to be most susceptible to the destructive effects of periglacial environments and contribute the most to the formation of new sandy textures.