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Welding of Pyroclastic Conduit Infill: A Mechanism for Cyclical Explosive Eruptions

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Vulcanian style eruptions are small to moderate sized singular to cyclical events commonly having volcanic explosivity indices (VEI) of 1-3. They produce pyroclastic flows, disperse tephra over considerable areas and can occur as precursors to larger (e.g. Plinian) eruptions.
Here we present a study on the evolution of the physical properties (strain, porosity, permeability and ultrasonic wave velocities) of breadcrust bombs recovered from the deposits of the 2350 B.P. eruption of Mt Meager, BC, Canada. These accessory lithics are fragments of welded intra vent deposits formed during compaction and deformation processes operating in the shallow (less than 2 km) conduit. The deformation experienced by these samples is a combination of compaction within the conduit and post-compaction stretching associated with the subsequent eruption.
Our results highlight a profound directionality in the measured physical properties of these samples related to the deformation-induced fabric. Gas permeability varies drastically with increasing strain and decreasing porosity along the compaction direction of the fabric. However, permeability varies little along the elongation direction of the fabric. Similarly, ultrasonic wave velocities increase along the compaction direction and remain unaffected along the direction of fabric stretching; Poisons ratio increases along the fabric stretching direction.
We combine these physical property measurements with models describing the timescales of porosity loss and to explore the timescales of permeability reduction and re-pressurization of the edifice. Modelling results and reconstruction of the deformation history also suggest the potential for a low-cost technique for monitoring the pressure build-up within volcanic systems based on fumarolic activity.