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LETTER

Rapid solid-state sintering in volcanic systems

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ABSTRACT

Solid-state sintering is a process wherein atomic diffusion along grain boundaries converts unconsolidated, crystalline aggregates into dense composites. It is a process that has largely been overlooked as significant to volcanic systems. Here, we present a preliminary suite of hot isostatic pressing experiments performed on naturally occurring crystalline dacite powders that demonstrate the efficacy of solid-state sintering at elevated pressures (40, 70 MPa) and temperatures (700–900 °C) over short timescales (2.5 days). The experimental products are dense, low-permeability rocks, supporting the hypothesis that solid-state sintering may be an important process that acts on timescales relevant to magma rise and eruption. We use the experimental data to constrain a preliminary model for the extent of densification as a function of temperature, confining pressure and time. Last, we present *sintering maps* relevant to the time-dependent loss of porosity and permeability in granular volcanic materials. Solid-state sintering is a densification process with the capacity to heal fluid-flow pathways in volcanic systems within months to years.

Keywords: Experiments, modeling, hot isostatic pressing, permeability, Mount St. Helens, densification