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LETTER

A low-load, high-temperature deformation apparatus for volcanological studies

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ABSTRACT

We describe a new experimental apparatus designed to perform high-temperature, low-load (<1136 kg) deformation experiments relevant to volcanology. The apparatus accommodates samples that are up to 7.5 cm in diameter and 10 cm long, and can be used to run constant displacement rate and constant load experiments. The rig is ideal for volcanological studies because it uses experimental conditions that closely match those found in volcanic processes: temperature (25 to 1100 °C), stress (0 to >50 MPa), strain rates (10^{-6} to 10^{-2}s), and total strains of 0 to >100%. We present experimental data that show how total strain (ε_T) is distributed in pyroclastic material during welding. Our experiments use cores of analogue (glass beads) and natural (ash and pumice) materials. Coaxial deformation of the glass beads involves equal amounts of axial (ε_a; volume strain) and radial (ε_r; pure shear strain) strain until 40% strain where porosity is reduced to less than 10%. Radial strain dominates at this point. Natural materials show a different pattern because both the matrix and clasts are porous. High ratios of ε_a to ε_r are maintained until all porosity is lost ($\varepsilon_T \approx 80\%$). The implication is that welding in pumiceous pyroclastic deposits proceeds mainly by volume strain; in natural materials, pure shear strain is minimal except in special circumstances.