



Experimental constraints on steam-driven eruptions at White Island volcano (New Zealand)

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The recent activity at White Island volcano is primarily characterized by strong hydrothermal activity interspersed by sequences of phreatic and phreatomagmatic eruptions, down to micro-eruptions through a mud-rich crater lake. We analyzed the response of various sample types to rapid decompression caused by steam-flashing and/or gas expansion, mimicking steam-driven (phreatic) eruptions. The samples investigated comprise unconsolidated ash/lapilli as well as consolidated ash tuffs with different degree of alteration. All sample sets underwent, where possible, microstructural, geochemical and petrophysical characterization (as porosity, permeability and uniaxial compressive strength (UCS)). This allowed us to assess the role of following factors for phreatic eruptions: (1) PT-conditions leading to either steam-flashing or steam expansion (2) the behavior of loose versus consolidated material, as the influence of fragmentation, ejection velocity, grain size reduction (3) the porosity and its changes, (4) the alteration of the samples, leading to changes in UCS, porosity, and permeability. Besides their role during the short moment of a phreatic eruption itself, the strength and the permeability of rocks of the entire White Island volcanic complex and in detail above the hydrothermal system in the crater area are key factors for the recent activity at White Island. They crucially influence the distribution of fluids and gases; strong and low-permeable layers can act as pressure seals, defining the area and overpressure of a steam-driven eruption.