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Relating Seismic Velocities, Permeability and Crack Damage in nterpreting the Mechanics of Active Volcanoes

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The physical state of volcanic rocks has been recognised as crucial in determining preferential penetration of magma or steam in local fractures, hydrofracturing by magma injection, development of shear zones during indentation, and the response to the pressurization of fluids within the rock matrix. We report simultaneous laboratory measurements of seismic velocities and fluid permeability on Etna basalt and Campi Flegrei Tuff. We show on the basis of experimental and modelling work that structural interpretations from tomographic studies can be improved significantly if the effects of changes in rock velocities due to changes in microstructure caused by changes in environmental variables are taken into account. In particular, changes in effective pressure conditions, changes in temperature and changes the degree of water saturation with depth all impact significantly on the propagation of elastic waves and transport properties. These results have also a profound implication for understanding the mechanics of volcanoes edifice weakening under the cyclical magma pressurisation.