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Seismic attenuation and scattering tomography of rock samples using stochastic wavefields: linking seismology, volcanology, and rock physics.

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Seismic attenuation and scattering are two attributes that can be linked with porosity and permeability in laboratory experiments. When measuring these two quantities using seismic waveforms recorder at lithospheric and volcanic scales the areas of highest heterogeneity, as batches of melt and zones of high deformation, produce anomalous values of the measured quantities, the seismic quality factor and scattering coefficient. When employed as indicators of heterogeneity and absorption in volcanic areas these anomalous effects become strong indicators of magma accumulation and tectonic boundaries, shaping magmatic chambers and conduit systems.

We perform attenuation and scattering measurements and imaging using seismic waveforms produced in laboratory experiments, at frequencies ranging between the kHz and MHz. As attenuation and scattering are measured from the shape of the envelopes, disregarding phases, we are able to connect the observations with the micro fracturing and petrological quantities previously measured on the sample. Connecting the imaging of dry and saturated samples via these novel attributes with the burst of low-period events with increasing saturation and deformation is a challenge. Its solution could plant the seed for better relating attenuation and scattering tomography measurements to the presence of fluids and gas, therefore creating a novel path for reliable porosity and permeability tomography. In particular for volcanoes, being able to relate attenuation/scattering measurements with low-period micro seismicity could deliver new data to settle the debate about if both source and medium can produce seismic resonance.