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Slow dynamics in saturated Bentheimer sandstone

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Rocks exhibit astonishing time dependent mechanical properties, like memory of experienced stress or slow dynamics, which refers to a transient recovery of stiffness after a softening induced by almost any type of loading. This softening and transient recovery is observed in the subsurface and in buildings after earthquake shaking, or in laboratory samples.
We investigate the anisotropy of nonlinear elastic behavior and slow dynamics in water-saturated Bentheimer sandstone subjected to 3 MPa of pore pressure, 5MPa of confining pressure, and different amplitudes of uniaxial strain. An array of P-wave transducers allows us to perform relative velocity change measurements for the duration of the whole experiment along different propagation angles.
We then fit our measurements to a simple model separating the velocity changes into angle-dependent classical nonlinear and nonclassical nonlinear components, and look into the uncertainties associated with our model parameters. Our results, compared with ones obtained in a dry setting, illuminate the complex interplay of pore fluids and excitation amplitude on the slow dynamics response of the material.

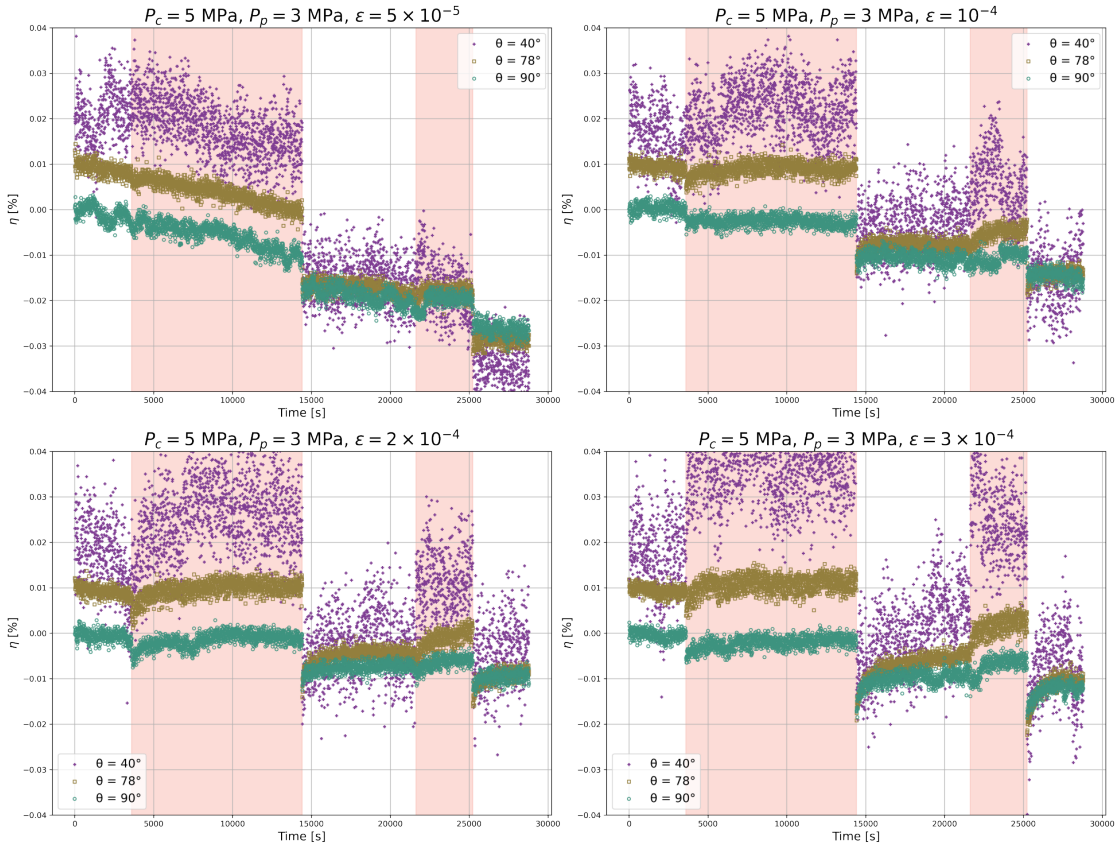

Figure 1: Relative velocity change measurements for different strain amplitudes and different angles between the probe P-wave propagation path and the loading axis

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