



## **Observation of transient seismic velocity variations allow monitoring of field scale pressure changes during high-pressure fluid injection**

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Pressure propagation during high-pressure fluid injection in the crystalline earth's crust is inherently difficult to measure. Here, we show that seismic p-wave velocity changes respond to pressure propagation during a 20-m scale hydraulic stimulation experiment in a crystalline rock mass. We use traveltimes recorded during repeated active seismic surveys accompanying fluid-injection to derive a time-varying 3D seismic velocity model. Fluid pressure and deformation measurements within the rock volume allow – for the first time - a direct comparison with observed seismic velocities. Velocity changes are proportional to pressure changes, so that the pressure propagation throughout the rock volume can be deduced from the transient velocity model. Also, pressure-driven reversible deformation can be predicted from the seismic velocity variations, while irreversible deformation like shear-displacement along pre-existing fractures or hydraulic-fracturing has no observable effect on seismic velocities. Our quantitative observation demonstrates the potential of seismic velocity monitoring to infer pressure propagation in deep reservoirs. This leads us to the question if monitoring of seismic velocities during hydraulic stimulations may be a better proxy to infer pressure propagation (and possibly stimulated rock volume) than microseismicity.