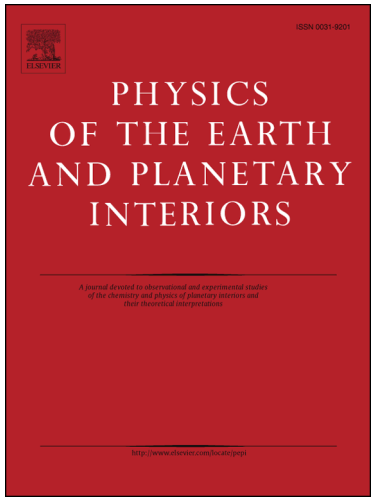

Remote monitoring of the mechanical instability induced by fluid substitution and water weakening in the laboratory

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Remote monitoring of the mechanical instability induced by fluid substitution and water weakening in the laboratory.

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Abstract

We studied the effect of fluid injection on the mechanical behaviour of the poorly consolidated and layered Sherwood sandstone under varying stresses, with micro-seismic (MS) monitoring. In order to highlight possible weakening effects, water and inert oil have been injected into critically-loaded samples to assess their effect on strength and elastic properties, derive the ultrasonic signature of the saturation front for each fluid, and the potential development of damage. To this end, the specimens were instrumented with 16 ultrasonic P-wave transducers used for both passive and active monitoring during loading and fluid injection. A first set of injection tests in hydrostatic conditions, using either water or inert oil, has been performed on samples subjected to low confining pressure. Water invasion in the pore space induces a significant decrease of the P-wave velocity, whereas oil invasion shows a velocity increase. The velocity decrease associated with water injection is analysed in terms of attenuation mechanisms and corresponding critical frequencies. A second series of injection tests with the same fluids has been performed during creep tests on critically-loaded samples. The development of mechanical instability inducing micro-seismic activity is observed only when water is injected into the sample. The recorded micro-seismic events are spatially and temporally located thanks to the dedicated velocity models accounting for the