

Accepted Manuscript

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

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PII: S0031-9201(16)30112-1
DOI: <http://dx.doi.org/10.1016/j.pepi.2016.06.011>
Reference: PEPI 5943

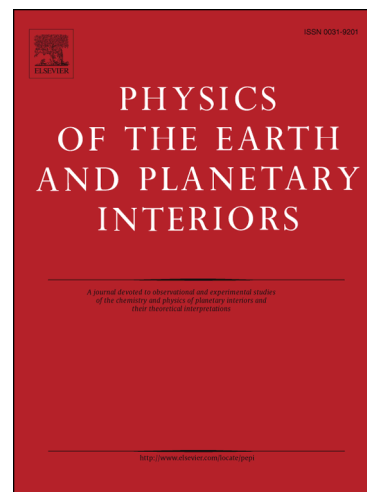
To appear in: *Physics of the Earth and Planetary Interiors*

Received Date: 15 December 2015

Accepted Date: 26 June 2016

Please cite this article as: Dautriat, J., Sarout, J., David, C., Bertauld, D., Macault, R., Remote monitoring of the mechanical instability induced by fluid substitution and water weakening in the laboratory, *Physics of the Earth and Planetary Interiors* (2016), doi: <http://dx.doi.org/10.1016/j.pepi.2016.06.011>

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

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7

8 **Abstract**

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

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