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22 Oct. 2020

Editorial Office

JGR

Dear Editor,

We are submitting the attached manuscript entitled “***Imaging elastodynamic and hydraulic properties of in-situ fractured rock: An experimental investigation exploring effects of dynamic stressing and shearing”*** by *Clay Wood, P. Shokouhi, P. Manogharan, J. Rivière, D. Elsworth, C. Marone* for consideration as a letter in EPSL. This work addresses fundamental questions surrounding temporal changes in physical properties prior to earthquake failure (precursors) and their underlying physical mechanisms.

We describe laboratory experiments to elucidate the relationship between nonlinear elasticity and permeability evolution in fractured media subjected to local stress perturbations. This study is part of an effort to image fluid pathways and fracture properties using active-source acoustic monitoring during fluid injection and shear of rough fractures. Experiments were conducted with L-shaped samples of Westerly granite fractured in-situ under tri-axial conditions with deionized water subsequently circulated through the resulting fractures. After in-situ fracturing, we separately imposed oscillations of the applied normal stress and pore pressure with amplitudes ranging from 0.2 to 1 MPa and frequencies from 0.1 to 40 Hz. During these dynamic perturbations an array of piezoelectric transducers continuously transmitted ultrasonic pulses across the fracture to monitor the evolving elastic response. We interpret the resulting evolution of elastic wave properties in the context of elastic nonlinearity and relate the estimated nonlinearity parameters to the relative change in permeability of the fractured media. Fracture roughness is then altered in-situ by shearing, with the generation of breccia and wear products. We document the evolution of permeability and fracture contact stiffness as a function of dynamic stressing and shear offset and discuss our findings in relation to fractures in Earth's crust.

This manuscript contains original work that has not been submitted for publication to another journal or conference proceeding. All authors have approved the submission of this manuscript.

We have included a list of potential reviewers below. If you have any questions please do not hesitate to contact us.

Sincerely,

Clay Wood (for all authors)

Potential referees (in alphabetical order):

* Thibault Candela, Applied Geosciences, TNO, Netherlands, thibault.candela@tno.nl
* Bill Carey, Los Alamos National Laboratory, bcarey@lanl.gov
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