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Episodic tremor and slip explained by fluid-enhanced microfracturing and sealing

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Observed episodic tremor and slip along plate interfaces are systematically highlighted by over-pressurized fluids and near failure shear stress conditions at brittle-ductile transition. Based on a ductile grain size-sensitive rheology with microfracturing and sealing as grain size decrease and increase processes respectively, we propose a new mechanical approach that provides a mechanical and field-based explanation of such phenomena. We also modeled pore fluid pressure variation as a function of changes in porosity/permeability and strain rate-dependent fluid pumping. The fluid-enhanced dynamic evolution of microstructure defines cycles of ductile strain localization related with increase in pore fluid pressure. We propose that slow slip events are ductile processes related to transient strain localization, while non-volcanic tremor correspond to fracturing of the whole rock at peak of pore fluid pressure. As novelty, our model also shows that the availability of fluids and the efficiency of fluid pumping control the occurrence and the P-T conditions of episodic tremor and slip.