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Keynote: Going from cold to hot with John Rudnicki

Rice, James, rice@seas.harvard.edu, Harvard University

ABSTRACT

In his earliest scientific work, John W. Rudnicki began studies on shear localization, which helped clarify widely observed process in rock and soil mechanics (and metals and polymers too) and which he ultimately generalized to a novel and highly informative approach to understanding compaction bands in porous rocks. His early studies did consider possible interactions of the deforming solid, when porous, with infiltrating pore fluids, but they made no particular reference to the effects of temperature changes during deformation. That changed most significantly in a pair of recent articles (slated for publication in *J. Geophys. Res. – Solid Earth* in mid-2014) which the present author had the pleasure of working on with Professor Rudnicki, together with Harvard graduate student, soon to be Ph.D., John D. Platt. Those works are summarized in this presentation. They address the thermo-hydro-mechanical basis for the stability and localization of rapid shear in fluid-saturated fault gouge, and provide a basis for understanding the incredible localization of the zone of highest shear along faults during earthquakes, often to regions <100 microns width. In addition, the new perspectives on faulting allow us to understand the physics of dynamic weakening during earthquakes and help resolve old paradoxes concerning how frictionally strong materials can exhibit transiently low strength and produce little heat outflow during rupture.