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Propagation of friction waves along a fault

Iuliia Karachevtseva (2), Arcady Dyskin (1), and Elena Pasternak (2)

(1) University of Western Australia, School of Civil, Environment and Mining Engineering, Crawley, Australia (arcady_m@me.com), (2) University of Western Australia, Mechanical and Chemical Engineering, Crawley, Australia

Sliding over pre-existing fractures and interfaces is one of the forms of instability in geomaterials. It is often accompanied by stick-slip – a spontaneous jerking motion between two contacting bodies, sliding over each over. In the Earth's crust stick-slip in fault sliding is associated with the occurrence of earthquakes. Conventionally, the mechanism of stick-slip is assumed to be associated with intermittent change between static and kinetic friction and/or the rate dependence of the friction coefficient. We however found that the stick-slip type behaviour can be caused by elastic oscillations of the rock even when the friction coefficient is constant. We present a model that shows that the zones of non-zero sliding velocities move with a p-wave velocity along the fault. This fast (supersonic with respect to the s-wave velocity) movement can be explained by the fact that the rock on both sides of the fault experiences normal strain in the direction of the fault. This type of deformation is characteristic to p-wave velocity. This is consistent with the observed supersonic (with respect to the s-waves) rupture propagation over faults. The amplitudes of disturbances decrease with the time.