Geophysical Research Abstracts
Vol. 18, EGU2016-2446, 2016
EGU General Assembly 2016

Fan-structure waves in shear ruptures

Boris Tarasov
The University of Western Australia, Perth, Australia (boris.tarasov@uwa.edu.au)

This presentation introduces a recently identified shear rupture mechanism providing a paradoxical feature of hard rocks – the possibility of shear rupture propagation through the highly confined intact rock mass at shear stress levels significantly less than frictional strength. According to the fan-mechanism the shear rupture propagation is associated with consecutive creation of small slabs in the fracture tip which, due to rotation caused by shear displacement of the fracture interfaces, form a fan-structure representing the fracture head. The fan-head combines such unique features as: extremely low shear resistance (below the frictional strength), self-sustaining stress intensification in the rupture tip (providing easy formation of new slabs), and self-unbalancing conditions in the fan-head (making the failure process inevitably spontaneous and violent). An important feature of the fan-mechanism is the fact that for the initial formation of the fan-structure an enhanced local shear stress is required, however, after completion of the fan-structure it can propagate as a dynamic wave through intact rock mass at shear stresses below the frictional strength. Paradoxically low shear strength of pristine rocks provided by the fan-mechanism determines the correspondingly low transient strength of the lithosphere, which favours generation of new earthquake faults in the intact rock mass adjoining pre-existing faults in preference to frictional stick-slip instability along these faults. The new approach reveals an alternative role of pre-existing faults in earthquake activity: they represent local stress concentrates in pristine rock adjoining the fault where special conditions for the fan-mechanism nucleation are created, while further dynamic propagation of the new fault (earthquake) occurs at low field stresses even below the frictional strength.