"Fan"mechanism of shear ruptures - as a trigger of dynamic processes at seismic depths in the earth's crust

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Frictional stick-slip instability on pre-existing faults is well studied experimentally and considered as the general mechanism for shallow earthquakes. At the same time, post-peak properties of intact hard rocks under high confining stresses $\sigma 3$ corresponding to seismic depths of shallow earthquakes are still unexplored experimentally due to uncontrollable and violent failure of rock specimens even on modern stiff and servo-controlled testing machines. The lack of knowledge about post-peak properties of the majority of the earthquake host rocks prevents us from understanding and quantifying the contribution of these rocks to shallow earthquakes. This presentation discusses a recently identified shear rupture mechanism operating in hard rocks under high $\sigma 3$ which causes dramatic rock weakening and embrittlement (by tenths of times) during the post-peak failure. The new mechanism is associated with the intensive tensile-cracking process in the rupture tip observed for all extreme ruptures. The tensile-cracking process creates, in certain conditions, a fan-like fault structure, the shear resistance of which is extremely low. The fan-structure represents the basis of a self-sustaining natural mechanism of stress intensification in the rupture head providing the driving power for rupture propagation with extreme velocities. The fan-mechanism causes dramatic embrittlement of intact hard rocks under high stress and makes transient strength of intact hard rocks during the rupture propagation significantly less than the frictional strength. This paper introduces features of the fan mechanism operation in primary ruptures and in natural complex faults and proposes an alternative view on the nature of earthquakes and shear rupture rockbursts where the fan-mechanism represents the trigger of dynamic events at seismic depths of the earth crust.