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Fault on/off

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Within the crust, the life of seismogenic normal and thrust faults crossing the brittle-ductile transition is here inferred as controlled by the conflicting behavior of the steady-state kinematics in the ductile regime with respect to the stick-slip brittle regime. Along a normal fault, the earthquake is associated with the coseismic closure of the stretched hanging wall band generated during the interseismic period close to the brittle-ductile transition. Besides the shear stress overcoming the friction of the fault, the brittle fault moves when the weight of the hangingwall exceeds the strength of the dilated band. Along a thrust fault, the seismic event is rather associated with the sudden dilatation of the previously over-compressed volume in the hangingwall. The motion of an active fault at the brittle-ductile transition can be compared to a spring anchored to the ductile and brittle parts of the hangingwall. During the interseismic period, along a normal fault the spring is elongated, whereas it is compressed in the convergent setting. During the coseismic stage, the two systems reverse, i.e., the spring is compressed along a normal fault, while it is elongated along a thrust.

The model predicts larger fluids discharge along a normal fault due to coseismic secondary porosity decrease, and vice-versa along a thrust fault. We tested the opposite scenarios with two examples from the Apennines and Taiwan. GPS data, fluid fluxes, energy dissipation and strain rate analysis support these contrasting evolutions. Our model also predicts, consistently with data, that the interseismic strain rate is lower along the fault segment more prone to seismic activation.