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Relationships between Earthquakes and Episodic Tremor and Slip

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The theoretical downdip limit of a plate interface seismogenic zone is marked by a transition from stick-slip to stable sliding behavior. While there are some indications this transition in behavior can be influenced by the rheological brittle-ductile transition of crust or mantle rocks, ultimately the change in behavior is due to a change in frictional stability. A change in the velocity dependence of friction from velocity weakening (unstable) to velocity strengthening (stable) is thought to control where earthquakes can no longer nucleate, but the transition zone is often defined as a conditionally unstable zone where earthquakes cannot nucleate but ruptures can propagate via dynamic loading. Recent advances in seismic and geodetic monitoring have led to improved measurements of fault structure and behavior where this transition is expected in the Earth, including the discovery of a new family of slow earthquake phenomena. In this study, I compare a host of observations near the down-dip end of the seismogenic zone from a variety of different fault zones to look for clues about the nature of this stability transition. This comparison reveals the transition does not follow a simple generalized pattern, with variable existence and spatial extent of microseismicity, postseismic transients, slow slip, tremor, high conductivity, seismic velocity anomalies, and increased fault coupling. Nevertheless, there are several instances of similar spatial relationships between earthquakes and episodic tremor and slip that appear to delineate the transition in frictional behavior.