



Variability of Earthquake Rupture Velocity: Possible Origin and Implications

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Recent observations show that the speed at which a fault ruptures during an earthquake is much more variable than previously thought. This variability is also observed in laboratory experiments (Xia et al, 2004) and in numerical simulations (Peyrat et al, 2001). Fast, supershear ruptures observed during the Imperial Valley, Izmit, Kunlun, and Denali earthquakes occur over fault segments which exhibit remarkably simple morphology. In contrast an event like the Hector Mine earthquake where the fault has a complex geometry and had not ruptured for thousands of years has an extremely low rupture velocity. The fault morphology and the level of initial stress may be the factors which control the rupture speed. Another observation is that supershear ruptures seem associated with unusually low ground accelerations, suggesting a smooth rupture process. This and recent results which show that near-fault recordings of supershear rupture provide a direct view into the faulting process (Bernard and Baumont, 2004) yield valuable information on friction law parameters. A final observation that we will discuss is that for all the earthquakes in which we have an indication of supershear, fault branching occurs in the later stage of the rupture.