Geophysical Research Abstracts
Vol. 14, EGU2012-11388-1, 2012
EGU General Assembly 2012

Dynamic friction of soft solids studied by ultrasonic speckle interferometry: slow slip and supershear rupture

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To get an insight into the processes underlying dynamic friction that plays an important role in seismic sources, we developed a sliding dynamic experiment coupled to ultrafast ultrasonic imaging. This experimental setup permits to observe simultaneously the frictional interface and the waves emitted in the bulk during slipping. We use soft solid sliders made of hydro-organic gel of polymer (PVA), in contact with either glass or sandpaper. In these soft solids, ultrasonic speckle interferometry imaging allows to follow quantitatively the wave field emitted by dynamic friction. Moreover, this imaging method is non-intrusive and well resolved in space and time. It is thus possible to characterise the small scale processes that occurs at the interface during global large scale sliding.

We investigate the friction in two different dynamic regimes. In the case of friction on a rough interface (sandpaper), we observe a global behaviour of slow slip events. These slow slip events are correlated with bursts of depinning events occurring at small scale at the interface. In the case of friction on a smooth interface (glass, with an interlayer of sand), ultrasonic imaging reveals that the sliding regime is different and that dynamic rupture propagation prevails. The rupture fronts are propagating at supershear velocity, emitting an elastic Mach wave that is very clearly observed. In this dynamic rupture regime, we add some barriers and present an experimental observation of the effect of barriers on a propagating rupture front.