

# Supersonic propagation of slow slip rupture during rock friction experiments

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Rupture propagation speed on the fault has been considered to be slower than elastic wave velocities of the material. Exceptions were when extremely high energy is imposed, much higher than the fracture energy needed for the rupture to advance. The rupture propagating faster than the elastic velocities is called supersonic rupture. We observed such supersonic rupture propagation of slow slip events during large scale rock on rock friction experiments on a  $1.5 \times 0.1 \text{ m}^2$  fault using Indian metagabbro rock specimens. Such slow slip events were accompanied by low frequency vibrations whose onsets were synchronized with those of slow slip events; they also propagated faster than the elastic wave velocities of the rock. Since typical precursory slow slip and coseismic slip events have been observed on the same fault in a sequence of the friction experiment, the slow slip events with supersonic rupture might share the same friction environment as that for the typical preslip-mainshock type events. We interpret this phenomenon as an occurrence of non-linear deformation of a very thin layer on the fault surface. For linear deformation case, the limitation of propagation velocity comes from the elastic property of rock specimens, but non-linear deformation can propagate independently of the material elastic constants but the propagation velocity tend to be proportional to the strain rate. In addition, because there are several similarities between the present observation and the slow slip events observed in the subduction zone worldwide, it may provide a clue to understand these phenomena.

Keywords: supersonic rupture propagation, rock friction experiment, slow slip event