The physical origin of dynamic triggering of earthquakes (i.e., by transient seismic waves) remains one of the least understood aspects of earthquake processes. Here we show that the non-equilibrium dynamics and the nonlinear elastic behavior of the fault core under the influence of a seismic wave may be responsible for dynamic triggering of earthquakes. Our hypothesis is based on recent acoustic resonance experiments conducted in granular media (a surrogate for fault gouge) under different applied effective pressures. We found that as the input amplitude is increased the resonance frequency of the Young's fundamental mode decreases and resonance peak broadens, corresponding to a decrease in velocity or modulus and an increase in nonlinear dissipation respectively. For dynamic strains ranging from 10^{-7} to 10^{-6} comparable to those that are assumed to trigger earthquake, we measured the modulus softening of granular materials up to 5\% at low effective pressure of about 70 kPa. As in rock, the granular medium exhibit significant slow dynamics, manifested by a logarithmic recovery of the modulus that can take hours (Johnson & Jia, Nature, 2005). This laboratory experiment leads us to propose a conceptual model that seismic waves from a distant earthquake impinge on a fault that is critically stressed, temporarily decreasing the core modulus. The modulus decrease corresponds to an abrupt material strength decrease sufficient to induce fault slip, while slow dynamics may well play an additional role in delayed triggering.

Mots-clé:
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