## Fracture in brittle heterogeneous material: crackling and seismicity

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The problem of the solid fracture has occupied scientists and engineers for centuries. This phenomenon is classically addressed within the framework of continuum mechanics. Still, stress enhancement at crack tips makes the failure behavior observed at the continuum-level scale extremely dependent on the presence of microstructure inhomogeneities down to very small scales. This yields statistical aspects which, by essence, cannot be addressed using the conventional engineering continuum approaches. I addressed this problem from two different points.

First, I designed an experimental setup that allows growing well-controlled tensile cracks in brittle heterogeneous solids of tunable microstructure, over a wide range of loading speed. The crack dynamics and the evolution of stored and released mechanical energy are monitored in real time.

In parallel, the acoustic emission going along with crack growth is recorded via a series of acoustic transducers, and analyzed in a way similar to that develop by geophysicists to process seismic signals. The experiments allowed me to characterize quantitatively the crackling dynamics of cracks, also to evidence intriguing statistical similarities between the seismicity associated with this simple situation of a single running crack under tension and the much more complex situation of multicracking in compressive fracture and in earthquakes.

In parallel, I addressed the problem numerically. The simulations invoke a recent statistical model mapping heterogeneous fracture with the depinning transition of an elastic manifold in a random potential. The numerical exploration of the parameter space allowed me to unravel when (i.e. which loading conditions, microstructure material parameters, material constants...) regular dynamics compatible with continuum approaches are expected to be observed, and when crackling dynamics calling for statistical approaches are observed. In this latter case, we have characterized quantitatively the dynamics statistic and its variations as a function of the input parameters

Seismicité le long de San-Andreas



Longitude



Localisation acoustique sur une expérience de fissuration en tension