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Comparison of optical and acoustical monitoring during a crack propagation, implication for slow earthquake dynamics

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Observations of aseismic transients in several tectonic context suggest that they might be linked to seismicity. However a clear observation and description of these phenomena and their interaction is lacking. This owes to the difficulty of characterizing with a sufficient resolution processes taking place at depth. Here we aim to study these interactions between aseismic and seismic slip taking advantage of an unique experimental setup.
We conducted a series of mode I crack propagation experiments on transparent materials (PMMA). The crack advance is trapped in a weakness plane which is the interface between two previously sandblasted and annealed plexiglass plates. A fast video camera taking up to 500 frames per second ensures the tracking of the front rupture. The acoustic system is composed of a maximum of 44 channels continuously recording at 5 MHz for a few tens of seconds. Piezo-electric sensors are composed of a 32 elements linear array and individual sensors surrounding the crack front. An automatic detection and localization procedure allows us to obtain the position of acoustic emission (A.E.) that occurred during the crack advance. Crack front image processing reveals an intermittent opening which might be linked to the time and space clustering of the AE. An analogy between the mode I (opening) and the mode III (antiplane slip) allows us to interpret our results in term of slip on faults. Our experiment thus helps to reveal the interplay between seismic and aseismic slip on faults.