Geophysical Research Abstracts, Vol. 9, 08677, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-08677

Optical and seismic imaging of an interfacial crack front between two annealed rough surfaces

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The role of heterogeneities in the nucleation and propagation of rupture is an important issue in earthquakes science. Indeed the geometry of fault surfaces controls the contact between the two blocks of rock and thus influences the mechanical behavior of fractures. To study this geometry we developed a laboratory experiment which implies a mode I fracturation between two annealed plexiglas plates. Analogies exist between mode I and mode III rupture, which allows to get from one problem to another. The two annealed surfaces were chemically depolished, thus making the toughness vary spatially. The propagating rupture front is followed optically with a digital camera thanks to the transparency of the PMMA plates. The interfacial crack front is self-affine in a statistical sense, this scaling is characterized by the roughness exponent. So we analyse the front with some statistical methods in order to get a value of the in-plane roughness exponent. We can then compare our results concerning the disorder of fractured surfaces to other already published results.

Another part of the experiment is to characterize “seismically” the interface between the two depolished plates. Seismic imaging is possible thanks to a fast 64 channel data acquisition system linked with a linear array of piezoelectric transducers. The sensors can all be used in emitting and receiving modes at high frequencies. The transmitted waveforms can be computed and transferred to the transducers. We imitate the seismic imaging methods used to explore the subsurface to characterize our interface. We compare the seismic responses of both the opened part and the still annealed interface and try to get information on the geometry of the surfaces with the backscattered waves. We also want to record acoustic emissions with the same data acquisition system during the propagation of the rupture in order to localize the rupture zone.