Geophysical Research Abstracts, Vol. 7, 05775, 2005
SRef-ID: 1607-7962/gra/EGU05-A-05775

Seismic energy radiation from dynamic faulting

Raul Madariaga

Laboratoire de Géologie, Ecole Normale Supérieure, 24 rue Lhomond, 75231 Paris cedex 05, France (madariag@geologie.ens.fr)

Seismic radiation allows seismologists to probe the details of the rupture process during an earthquake. Waves recorded in the vicinity of the fault are used to invert for the details of rupture. Seismic radiation is not only a tool to probe the earthquakes, it is also the essential dissipative mechanism by which ruptures exchange energy with the surrounding elastic media. Inversion has been used recently to study several earthquakes at relatively long wavelength, extending these results to higher frequencies requires improved understanding of seismic energy balance, even if the fundamental theorems were established by Kostrov 30 years ago. In this paper we examine several simple earthquake models, and compute energy balance in detail. We show that energy can be expressed as simple integrals of energy release on the fault in a form that was previously proposed by Freund. From this expression we show that high frequencies are radiated by fast changes in rupture velocity and from jumps and kinks of the rupture front. Even if seismic energy can be expressed as an integral of slip on the fault, it is not possible to fully identify the place on the fault where seismic energy arrives to an observer at a given time. In order to attribute the amount of energy radiated by a certain segment of the fault requires solving a non-linear back-projection problem. This problem is well posed only if rupture velocity is known for every point on the fault. In reality, determining the rupture velocity is a much more difficult problem that computing the distribution of slip, so that I expect that much better rupture invertions will be required before we can fully identify the origin of seismic radiation on the fault. Another important issue that we explore is the role of seismic radiation as a dissipative mechanism in earthquake dynamics. Complex faults with kinks, discontinuities or strongly varying energy release rate produce much more radiation that acts as a throttle on rupture propagation. We estimate that seismic ruptures in mode II rarely become super-shear because of the strong geometrical complexity of real faults.