# Estimates of Seismic Fracture Energy for Large Earthquakes

# James Mori[1]; Kuo-fong Ma[2]

[1] EQH, DPRI, Kyoto Univ.; [2] Institute of Geophysics, National Central University

The seismic fracture energy, or amount of dissipative energy during the rupture, is a recent topic in understanding the source process of earthquakes. The amount of energy may be related to such effects as breaking of contact points on the fault, reducing the grain sizes of fault rock, or creating new cracks in the vicinity of the fault. Recent results (e.g. Abercrombie and Rice, 2005) suggest that there is a scaling with earthquake size. The seismic fracture energy is also related to the dynamic frictional level on the fault and related to the amount of heat produced.

We estimate the amount of seismic fracture energy from near-field seismograms of the 1999 Chi-Chi, Taiwan earthquake (Mw7.6). These records are located very close (within a few kilometers) to the fault and can be considered to be representative of the slip velocity and displacement for the nearby shallow portions of the fault. We use measurements on the observed records to directly estimate the seismic fracture energy for these regions of the fault that had large amounts of slip from about 2 to 8 meters. We also carried out forward calculations of synthetic seismograms to investigate the resolution of the parameter estimation. If the slip weakening distance is less than one meter, it is very difficult to resolve the seismic fracture energy.

Our results show that amount of seismic fracture energy is a significant portion of the energy and about 10 to 30% of the radiated seismic energy. The slip weakening distances are about 80 to 200 cm and there does not seem to be a strong dependence on the total amount of fault slip.

We also used the near-fault records to estimate the rupture speed for the earthquake. The arrivals of the near-field terms, indicate rupture speeds of 1.7 to 2.2 km/sec which correspond to about 0.6 to 0.8 times the shear velocity. The results of the seismic fracture energy and generally consistent with the estimates of the rupture speed.

A few near-field records for other large earthquakes (2000 Denali and 1999 Izmit) were used to check the consistency of the source parameter estimates.