Geophysical Research Abstracts, Vol. 9, 00379, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-00379

Frictional Control on Mainshock and Aftershock Rupture Planes

C. Collettini

(1) Geologia Strutturale Geofisica, Dipartimento di Scienze della Terra Università di Perugia, Perugia, Italy , (colle@unipg.it).

Deformation in the intraplate continental crust is characterised, to first order, by coherent stress patterns over large regions (e.g. Zoback & Zoback) and this suggests that the major earthquakes nucleating in these areas are controlled by large scale tectonic processes. 2D frictional fault reactivation theory explains well the geometry of moderate to large main shock fault-ruptures nucleating in extensional and compressional intracontinental environments (Sibson & Xie, 1998; Collettini & Sibson, 2001). In the two dimensional case, where the strike of the earthquake rupture is assumed to contain the σ_2 axis, the dip distribution of the ruptures are consistent with frictional theory predictions and faults possessing a friction coefficient μ_s =0.6, at the bottom of the Byerlee's (1978) range (Sibson & Xie, 1998; Collettini & Sibson, 2001). The prediction of frictional reactivation under Byerlee's friction law is also consistent with in situ stress measurements in deep boreholes (Townend & Zoback, 2000).

By applying 3D frictional fault reactivation it is possible to observe that aftershocks for two well-documented seismic sequences occurring in extensional and compressional environments, the 1997 M_w=6.0 Colfiorito sequence (Central Italy) and the 1999 M_w= 7.5 Chi-Chi sequence (Taiwan), respectively, nucleate on planes favourably oriented for frictional fault reactivation. In particular, 89% of 329 and 81% of 121 events for the Colfiorito and Chi-Chi sequences respectively, are the result of fault reactivation processes on geological structures that represent well oriented planes within the regional stress field. The nucleation of the aftershock ruptures on well-oriented planes for fault reactivation in the regional stress field, suggests that aftershock ruptures are mainly loaded to failure by tectonic stresses and the main shock induced stress perturbations, e.g. static stress changes or increase in fluid pressure, would trigger aftershocks on planes already close to failure.

References

- Collettini, C. and Sibson, R. H., 2001. Normal Faults Normal Friction?. Geology, 29, 927-930.

- Sibson, R.H., and Xie, G., 1998, Dip range for intracontinental reverse fault ruptures: Truth not stranger than friction? Seismological Society of America Bulletin, v. 88, p. 1014-1022.

- Townend, J., and M.D. Zoback, 2000. How faulting keeps the crust strong. Geology, 28, 399-402.

- Zoback, M.L., and Zoback, M.D., 1992. First and second order patterns of tectonic stress: The World Stress Map Project. J. Geophys. Res., 97, 11703–11728.