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Rupture Lengths of Brazilian Earthquakes from Relative Location of Aftershocks: Evidence for Depth Dependence of Stress Drops

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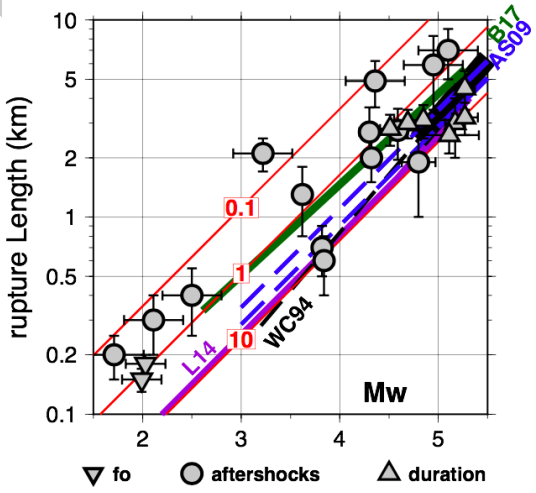
Abstract

Whether intraplate earthquakes have different average source properties, compared to interplate events, has been long debated. It has been proposed that intraplate events tend to rupture smaller areas with higher stress drops, compared to the average interplate earthquake. Here we estimate the rupture lengths of several Brazilian earthquakes by accurately locating their immediate aftershocks. The sparsity of stations in low-seismicity regions, such as Brazil, hinders accurate epicentral determination. We use cross-correlation of P-, S- and Lg waves to accurately locate the aftershocks relative to a reference event. In several cases, it was possible to infer the rupture length by the distribution of the early aftershocks; with the later aftershocks tending to span a larger area. We studied six different aftershock sequences using regional stations up to several hundred km distance. The mainshock occurs close to the foreshocks, which act as triggers to the main rupture. The immediate aftershocks tend to occur in a circle around a central (presumably stress-free) zone, which we interpret as the rupture of the mainshock. Published data from other events, based mainly on local networks, were added to provide an empirical relationship between rupture length and magnitude. These data suggest that stress-drops in Brazil vary mostly between 0.1 and 10 MPa, a similar range to many other studies worldwide. However, the mean stress drop (about 1 MPa) is smaller than the mean values of both interplate and intraplate events globally (mostly between 2 and 10 MPa). A possible dependence of stress drops with hypocentral depth may explain this difference: Brazilian intraplate earthquakes tend to be shallower than most other mid plate regions giving rise to smaller stress drops, on average. This result has important implications for seismic hazard estimation when GMPE equations from other intraplate regions are used in Brazil.



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