Are intraslab earthquakes stronger? A robust determination of *Q* and f_c and the scaling law between f_c and seismic moment

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ABSTRACT

An improved inversion technique effectively separates the frequency dependence of the source from the intrinsic attenuation of the medium. We developed a cluster-event method (CEM) in which clusters of nearby events, instead of individual events, pair with stations to form the basis for measurements of Q value and corner frequency (f_c). We assume that the raypaths from one cluster to a station share an identical Q while each event in the same cluster is allowed for only one f_c in the inversion process. This approach obeys the basic physics of earthquake sources and largely reduces the degrees of freedom of the inverse problem. An optimization algorithm of simulated annealing is employed to seek solutions to the non-linear inverse problem. The CEM was applied to events at 70 – 150 km depths in Japan subduction zone recorded by F-net. We demonstrate that corner frequencies are statistically better determined with CEM than with conventional methods, leading to a better constraint on Q. The resolved Q values in the mantle wedge increase from lower than 300 beneath the arc and back-arc to greater than 600 in the fore-arc region. The f_c's determined stress drops have a median of 22.5+- 6.7 MPa in Madariaga's (1976) form, compared with the stress drop of 3.3+-10.8 MPa for a global data set composed of previous measurements for crustal events. The f_c's satisfy a self-similar scaling relationship with seismic moment of $M_o \propto f_c^{-3}$, and merge concordantly with previous data except with an upward shift representing higher stress drop, verifying the earthquake self-similarity principle over a large range of seismic moment.