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Stochastic modeling and methods of inversion of high-frequency Lg coda with applications to Africa

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Abstract (summary)

A stochastic convolutional model for the generation and propagation of high-frequency Lg coda waves is proposed. In this model the effects of velocity dispersion, mode summation, mode conversions and scattering are expressed and discussed in detail. The randomness of Lg coda is modelled by band limited white, Gaussian noise. Based on this model, a stacked spectral ratio (SSR) method is developed to obtain Q values from single-trace Lg coda seismograms. Stacking over non-overlapping windows and averaging over adjacent frequencies are used to make single-trace measurements of Q more precise and stable. This model and method are tested using GDSN data from Africa. Under the assumption of a flat S-to-Lg transfer function and a flat site response, the model and method are extended to source spectra inversion.

Using an a priori assumption on the relationship between a single-trace measurement of Lg coda Q and the Lg coda Q as a spatial function, a tomographic method is developed to image the lateral variations of Lg coda Q. This method adopts an ART (back-projection) algorithm, which uses minimal computer time and storage size, and allows estimates of error and resolution.

These methods are used to regionalize Lg coda Q in Africa, using a large digital data set. Some events were also inverted for source spectra. The Lg coda Q structure correlates well with major tectonic features in Africa. Most of Africa is stable and has higher Q values. Regions of low Q-values include the East African Rift system, the Atlas mountains and Cape Fold Belt. The lateral variations of frequency dependence of Q correlates, in most regions with that of Q at 1 Hz. The resolving power of Lg coda Q imaging is comparable to that of surface wave velocity-tomography. The uncertainties in Lg coda Q and its frequency dependence are less than about 60 and 0.2 for most of Africa.

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