Characteristics of power-law decay and frequency dependence revealed from the analysis of seismic coda envelopes

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In 1969, Keiiti Aki first called the continuous wave trains in the tail portion of seismograms 'coda waves' and described the characteristics of coda waves in the lithosphere. Such seismic envelope of coda waves is an efficient measure to estimate physical parameters of the Earth heterogeneity. To date, coda envelopes have been described by bending curves which have several systematic changes in decay rate with lapse time in a log-log scale. For NS component seismograms of regional earthquakes recorded by 11 IRIS stations, applying the Hilbert transform to make seismic envelopes in period bands from 1/4-1/2s to seismic envelopes in period bands from 1/4-1/2s to 16-32s with lapse time as long as 4000s, we discovered that coda envelopes decay according to some power of lapse time measured from the origin time. It is new and different from the present knowledge about coda envelopes. The 'power-law' decay characteristics of seismic envelopes indicates that the spectra amplitude of seismic coda could be simply expressed as of the form A(t,Tc)˜tˆ-a(Tc), where t is lapse time and Tc is central period in second. According to regression analysis, we found that the exponent a value has period dependence and ranges a1=1.3˜6.5 (1/4-1/2˜16-32s), a2=0.6˜6.1 (1/2-1˜16-32s) for before and after ScS arrival, respectively. Moreover, it shows no significant difference between shallow and deep focus events shorter than 8s in period. The simple and distinct characteristics of seismic coda envelopes could provide reliable information to determine physical characteristics such as attenuation and to identify the regional difference of medium heterogeneity in the Earth.