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Envelope Synthesis of Long-Period Rayleigh-Waves: Single Isotropic Scattering Model on the Spherical Earth (Extended Abstract)

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In short-period seismograms of local earthquakes, we find a clear excitation of coda waves characterized by their smooth envelope decay. When we examine long-period seismograms, we can see also a clear excitation of incoherent wave trains in addition to Rayleigh waves propagating around the spherical Earth (see Figure 1). In the seismogram of the Kocaeli earthquake, Turkey for 100-200 s period recorded at station TYM, incoherent wave trains continued for more than 20 hours. There are two origins for these incoherent waves: scattering by distributed heterogeneities and/or topography changes, and the pulse decay due to velocity dispersion. Here, focusing on the former mechanism, we propose a simple method to synthesize the MS envelope of seismogram based on the radiative transfer theory for surface-wave energy propagation. We first model the Earth's surface by a scattering spherical-surface on which many

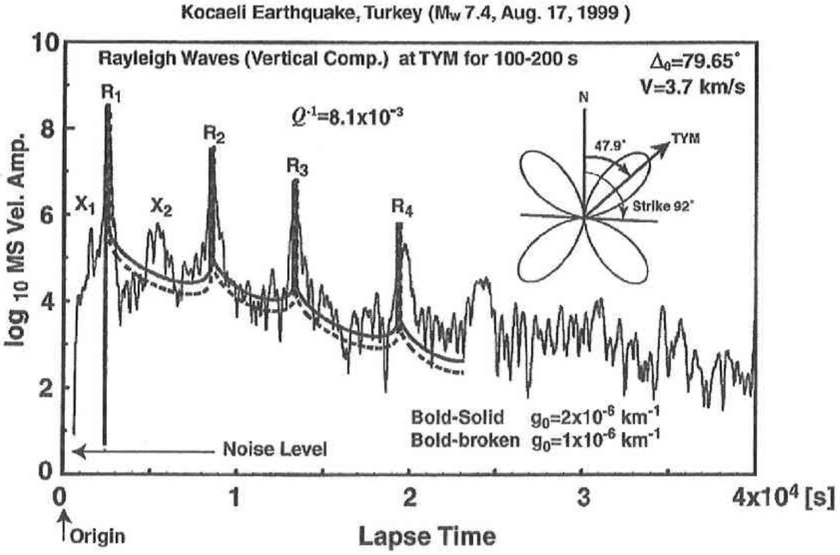

Fig. 1. A fine solid curve shows the MS-envelope of the vertical-component velocity-seismogram for period 100-200 s recorded at station TYM, Japan, where R_1, R_2, R_3 are Rayleigh waves of the fundamental mode and X_1, X_2 are overtones. A bold-broken curve and a bold-solid curve are theoretical curves for $g_0 = 1\times10^{-6}$ km^{-1} and 2×10^{-6} km^{-1}, respectively.

isotropic scatterers are randomly distributed. The scattering power per unit area is characterized by the total scattering coefficient, which is the reciprocal of the mean free path. A nonisotropic radiation source is put on the surface. For a given set of source-receiver pair, adding energy density singly scattered by scatterers distributed on a scattering isochronal curve for a given lapse time, we calculate the energy density at the receiver. Using spherical trigonometry, we calculate travel time and geometrical spreading. The time trace of the resultant energy density shows divergent peaks at arrivals of Rayleigh-waves propagating around the Earth and the excitation of scattered waves having concave curves between these peaks. These characteristics well explains observed MS envelopes of long-period vertical-components seismograms (see Figure 1). Analyzing seismograms of the Turkey earthquake recorded at 4 stations surrounding the epicenter, we estimated the total scattering coefficient to be about 2×10^{-6} km^{-1}, which is four orders of magnitude smaller that that for S-waves for 1-20 Hz in the lithosphere.