Seismic reflection surveys in randomly heterogeneous media -consideration on spatial sampling

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From the viewpoint of spatial sampling in reflection seismic exploration, we show effects of scattered waves on subsurface imaging by using numerical simulation of seismic wave field. We consider two types of noise in seismic waveform: one consists of the random noise in time series, and the other consists of incoherent scattered waves generated by random isotropic heterogeneity. The latter is a noise-like wave field caused by multiple scattering of seismic waves. Three types of data processing, conventional CMP stacking, poststack migration, and prestack time migration (PSTM), were applied to randomly heterogeneous model. Our numerical experiments indicate that denser the spatial sampling of seismic wave, lesser the random noise in seismic reflection image for the case of random time-series noise. On the other hand, the denser spatial sampling does not improve resolution of the section when subsurface structure contains random heterogeneity even if the interval of spatial sampling becomes shorter than the characteristic length of random isotropic heterogeneities. However, we demonstrate the possibility to estimate the average size of heterogeneities by differentiating two sections with different denser spatial sampling.