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# Estimation of scattering strength distribution based on seismic array observation (3)

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Ray directions of scattered waves can be determined as a function of slowness and azimuth from the array. Here, we propose a method to estimate spatial distribution of scattering strength.

First, we formulated relationship between energy of slant stacked waveform and scattering strength. Under the single scattering assumption by Sato (1977, 1982), scattered energy can be expressed as integration in whole space existing scatterers. The integration includes an array response function as weight function for direction of scatterer from the array. If we can assume that the array response function becomes delta function, the integration can be solved analytically. Then, three-dimensional distribution of scattering coefficient is calculated from slant-stacked energy multiplied a coefficient. The delta function assumption for array response is realized in the case of much large aperture array comparing with target wavelength. However, in practical cases, this assumption is not always reasonable.

In this study, we propose an algorithm to estimate scattering coefficient distribution for realistic cases.

For the observed array data, we apply major two processes. One is detection of scattered energy coming to an array. Another is estimation process from slant-stacked energy. The detection part is specialized to have high detectability. To get high resolution, a technique sacrifices accuracy of energy estimation. As detection techniques, we adopt four methods; semblance, capon spectrum, linear prediction method, and MUSIC spectrum. We select a most suitable technique by taking into account conditions of data quality, statistical features and so on. For the estimation process, we evaluate slant-stacked energy strictly. In order to estimate energy, we deconvolve array response for the scattered phases detected by the previous process. For the every scattered phases, waveforms are synthesized from source waveform and phase shift due to relationship between scatterer and location of sites. Then, slant-stacked energy can be calculated from these waveforms. Maximizing correlation coefficient between observed energy and model by least squares method, we obtain scattererd energy without effect of array response.

After above processing, lapse time, slowness vector, and scattered energy are obtained for major scattered phases. From these information and velocity structure of the crust, a location of inhomogeneity generating scattered waves at each phase can be calculated by back projection along ray path of scattered waves.