2観測点間の表面波位相・振幅データを用いた北米大陸上部マントルの3次元構造
3D shear wave structure in the North American upper mantle from interstation phase and amplitude data of surface waves

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The North American continent encompasses a variety of complex structural features, including regions with east-west extension, active volcanoes in the west, and stable cratons in the central and eastern areas. The high-quality broadband seismic data derived from the high-density Transportable Array (USArray) have facilitated many new tomographic studies in this region. We have recently developed a new technique to measure interstation phase speeds and amplitude ratios for fundamental-mode surface waves based on non-linear waveform fitting between two stations (Hamada and Yoshizawa, 2015, GJI). The amplitude anomalies of surface waves are affected by not only anelastic attenuation, but also elastic focusing/defocusing, which reflect the second derivatives of phase velocity across the ray path. Thus, the amplitude data are sensitive to shorter-wavelength structure than the conventional phase data.
The method has been applied to observed waveforms of USArray from 2007 to 2014, and we could achieve fairly uniform ray-path coverage across the U.S. We collect a large-number of phase speed and amplitude data for short interstation distances less than 1000 km, which can be helpful in enhancing the horizontal resolution of velocity models in North America. The measured interstation phase speed and amplitude ratios are inverted simultaneously for phase speed maps as well as local amplification factor at receiver locations. Our phase speed maps derived from both phase and amplitude data tend to exhibit better recovery of the strength of velocity perturbations than those from phase data only, with enhanced local-scale tectonic features characterized by strong velocity gradients. The results indicate that interstation amplitude data can be of help in reconstructing shorter-wavelength structures of the upper mantle.
Isotropic 3-D shear wave models in the depth range from 50 to 200 km are constructed from the phase speed maps of fundamental-mode Rayleigh waves. The isotropic S wave speed models show significant slow anomalies in Rio Grande Rift and Yellowstone in the western United States at shallower depth above 100 km. Smaller-scale tectonic features are also mapped clearly in the eastern areas; e.g., slow anomalies in New Madrid Seismic Zone as well as Great Meteor Hotspot Track, which can be found down to the depth of about 100 km.

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