Surface-wave tomography of the Atlantic region

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The two-dimensional group velocity distribution beneath the Atlantic Ocean is determined by inverting the fundamental-mode data of Love and Rayleigh waves in order to better constrain the structure and dynamics of the region.

The previous regional tomographic studies are carried out by using surface waves passing through both the oceanic and continental region to increase the path coverage. The velocity perturbations are represented with respect to the average velocity or global standard model (e.g., PREM). Velocities in continental regions can shift the average velocity level, and so it is possible that small anomalies in oceanic regions become invisible. In this study, we selected only the ray paths passing through the Atlantic Ocean to delineate images of the oceanic area with the effects of anomalies in the continental region.

We measured Love and Rayleigh wave group velocities along 975 paths connecting the epicenters and stations that pass through the Atlantic Ocean. The hypocenter parameters were taken from the Harvard centroid-moment tensor catalog. For each path, group velocities are measured by using the multiple filter technique (Dziewonski et al., 1969). They are then inverted to obtain tomographic images of group velocities in the period range of 18-200 s by using the inversion method of Kobayashi and Zhao (2004), which is based on Barmin et al. (2001).

The maps of Rayleigh wave group velocity distribution show that the Mid Atlantic Ridge (MAR) and ocean basins exhibit high velocity at periods from 18 s to 30 s, reflecting the surface topography and isostasy, respectively. The western part of the North Atlantic region at periods of 18 s and 20 s shows low-velocity anomalies, reflecting the thick sediment. The low-velocity anomalies beneath the MAR appear weakly at a period of 50 s and become stronger at longer periods. The MAR in the North Atlantic exhibits lower velocities than that in the South Atlantic. There are good correlations between some hotspots and low-velocity anomalies. For example, Azores, St. Helena and Tristan exhibit low velocity at the periods longer than 50 s. Active upwellings beneath the hotspots located around the MAR are considered to be responsible for slow anomalies.