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マルチモード表面波による大陸リソスフェアの３次元イメージング
3-D Imaging of Continental Lithosphere with Multi-mode Surface Waves

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Developments of high-density seismic arrays and techniques of seismic tomography in the last a few decades have enhanced the horizontal resolution of seismic images of the Earth's interior. Seismic surface waves are one of the most powerful tools to map 3-D images of the uppermost mantle, although its depth resolution is limited to the top 200 km as long as we use readily measurable fundamental-mode surface waves that are normally sufficient to map oceanic lithosphere with the thickness of about 100 km or less. On the other hand, high-resolution imaging of continental lithosphere, whose thickness tends to exceed 200 km beneath major cratonic areas, requires higher-mode data with greater sensitivities to the deeper structure. The use of higher-mode surface waves is, however, not straightforward, since several modes overlap in time and cannot be separated in a seismogram, particularly at short distances commonly used in regional-scale tomographic studies.

We present recent progress on the high-resolution regional-scale mapping of the continental upper mantle using multi-mode surface waves, with a particular focus on the 3-D imaging of radial anisotropy of shear wave speed as well as the lithosphere-asthenosphere boundary (LAB) beneath continental areas. Surface waves are inherently not very sensitive to the sharpness of boundaries due their long wavelength. The depth of LAB, however, can be estimated from the peak of negative gradient of a velocity model, while the thickness of LAB can be deduced from the sharpness of the velocity gradient. Using the recent continental tomography models of Australia and North America, we investigate the relationship between the distribution of LAB beneath the continents and the strength of radial anisotropy, which implies a significant correlation between the present-day plate motion and faster SH wave speed anomaly in the asthenosphere beneath the estimated LAB.

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