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3-D shear wave structure beneath Japan and its surrounding region from the two-station method of surface waves

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Isotropic and radially anisotropic three-dimensional shear wave structures of the upper mantle beneath the Japanese Islands and its surrounding regions are constructed from inter-station phase speeds of surface waves. We used the dense broadband seismic network (F-net) in Japan, and permanent stations of global seismic network in East Asia. A temporary broadband seismic network in Far-East Russia is also used in combination with the other permanent stations. We analyzed seismic events from 2005 to 2007 with moment magnitude greater than 6.0 and depth shallower than 100 km, and measured the phase speeds of the fundamental-mode Rayleigh and Love waves, using the conventional two-station method. About 5300 paths for Rayleigh waves and 3800 paths for Love waves have been collected to constrain phase speed maps in Japan and the Sea of Japan. An isotropic 3-D shear wave speed model is constructed from the fundamental-mode Rayleigh waves in the period range from 25 to 140 seconds, representing prominent fast wave speed anomalies in northeastern Japan, associated with the subducting Pacific plate. Lithosphere beneath the Sea of Japan is imaged as a fast wave speed layer with approximate thickness of about 60 +- 10 km, and is underlain by slow anomalies in the asthenosphere down to the depth of about 200 km. The low-angle subduction of the Philippine Sea plate is mapped clearly in southwestern Japan, indicating that the northern end of the plate extends beyond the northern coast of the Chugoku region. A conspicuous slow anomaly off the west coast of Kyushu is found in the depth down to about 130 km, which suggests the existence of an upwelling flow beneath this area. A radially anisotropic shear wave speed model is constructed using the phase speed maps of Rayleigh and Love waves in the period range from 30 to 80 seconds. A remarkably strong anisotropy (SH > SV) is found in the mantle wedge beneath northeastern Japan and the Ryukyu Islands, while only weak anisotropy can be seen beneath the Sea of Japan and within the Pacific plate.

Keywords: surface waves, tomography, Japanese Islands, anisotropy, two-station method