# Regional-scale variation of the lithosphere-asthenosphere system beneath the old Pacific ocean basin revealed by NOMan seafloor array observation

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We analyzed records of broadband ocean bottom seismometers (BBOBSs) in two areas in northwestern Pacific Ocean: area A (130Ma) and area B (140Ma) in northwest and southeast of Shatsky Rise. The BBOBSs are deployed by the Normal Oceanic Mantle (NOMan) project from 2010 to 2014. This study focuses on one-dimensional S-wave velocity ($V_{SV}$) structures in the oceanic lithosphere and asthenosphere by the array analysis of surface Rayleigh waves at a period range of 5—100 s.
The method for surface-wave analysis is cross correlation of ambient noise at periods shorter than 30 s and array analysis of teleseismic waves at longer periods. Although the detail of analysis is almost same as the previous studies for different areas in Pacific Ocean (Takeo et al. 2013, 2014, 2016), we improved two points to adjust to the small array size and strong azimuthal anisotropy in our study areas. We first changed the method of phase-velocity measurement for teleseismic waves. Since the array size is small compared to the wavelength, the frequency smoothness of dispersion curve must be increased to reduce uncertainty. In this study, we obtained "smooth" phase-velocity measurements for each teleseismic event by trying various S-wave velocity structures and searching for the best phase-velocity measurement corresponding to the best fitting structure. We then simultaneously estimated isotropic phase velocity and its azimuthal anisotropy for both teleseismic and ambient-noise analyses to avoid the bias of strong azimuthal anisotropy to isotropic measurements.
As a result of above modifications, we obtained improved isotropic and azimuthally anisotropic one-dimensional $V_{SV}$ models beneath two areas from Moho to a depth of 100—200 km. Despite of small difference in seafloor ages, $V_{SV}$ in area A is 2% smaller than that in area B at a depth range of 80—200 km even after correcting the effect of azimuthal anisotropy. This difference reveals the strong and small-scale variation in the oceanic asthenosphere, which might support the existence of small-scale convection beneath old oceanic lithosphere. The azimuthal anisotropy is stronger in the top of lithosphere than below, which may suggest larger shear accumulation during the seafloor spreading when Pacific plate was created 130—140 Ma ago. In area B, however, the fastest azimuth is not perpendicular to magnetic lineation, suggesting mantle flow not fully driven by the seafloor spreading at the mid ocean ridge.