Detection of the seismic anisotropy above D” discontinuity using broad-band data recorded at Lützow Holm Bay area

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We analyzed teleseismic shear waves recorded at five broad-band seismic stations in East Antarctica to investigate seismic anisotropy in the lowermost mantle beneath Antarctica. $V_{SV} < V_{SH}$ style anisotropy was observed and it is consistent with previous work [Usui et al., 2005; 2008]. However, we detected anisotropy even above the D" discontinuity unlike in previous studies. The differential travel time analyses were performed to construct a new transverse isotropic (TI) shear wave velocity model we call the "SYT2010" model. The V_{SH} structure of SYT2010 has a 1.0% discontinuity at the 2550km and the velocity is faster than PREM in the D" layer. On the other hand, the V_{SV} has no discontinuity and the velocity is lower than PREM. The maximum anisotropy above and below the discontinuity is 0.5 and 1.5%, respectively.

In order to clarify the origin of the anisotropy, we calculated the elastic anisotropy of polycrystalline aggregates (Pv + MgO) and (PPv + MgO) using PEA (polycrystalline elasticity analyzer). We modeled the anisotropy in several different lattice preferred orientation (LPO) directions with a different degree, where the pyrolitic volume fraction is set to be PPv (Pv) : MgO = 8 : 2. Transversely isotropic aggregate (TIA) of Pv with [100] vertical directions is likely cause of the anisotropy above D" discontinuity. The shape of the velocity gradient above the discontinuity is consistent with SYT2010 model. Assuming the origin of the anisotropy in the D" layer is PPv, TIA of PPv[001] is reasonable model. Although PPv[010] is thought to be the major cause of the D" anisotropy in previous works, our results suggest that only complete TIA of PPv[010] can explain the anisotropy. The most likely model is TIA of the MgO[100] model. The V_{SV} structure has weak discontinuity and the V_{SH} velocity jump is the same as 1.0% of SYT2010 at the depth of the discontinuity. Since the differential stress of $MgSiO_3$ is released due to refinement at the phase transition, much more anisotropic MgO exists in the D" layer.

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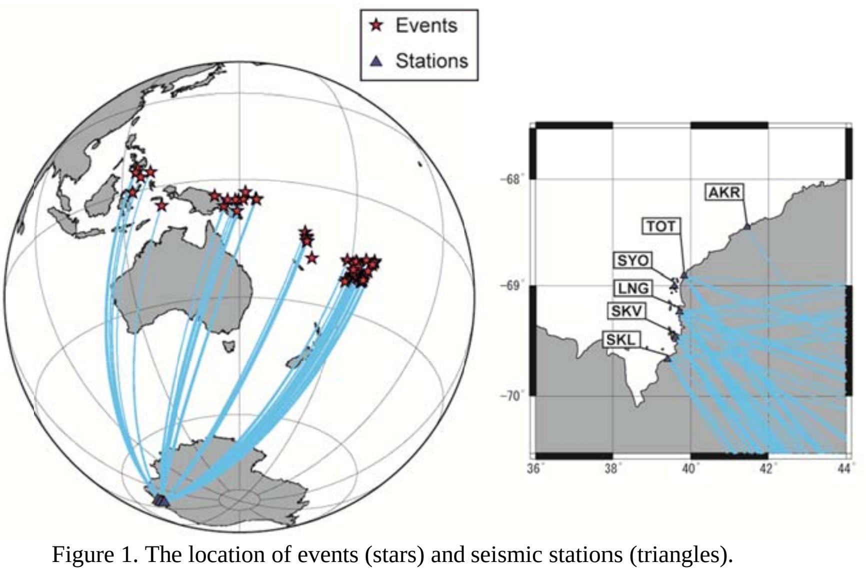

Figure 1. The location of events (stars) and seismic stations (triangles).

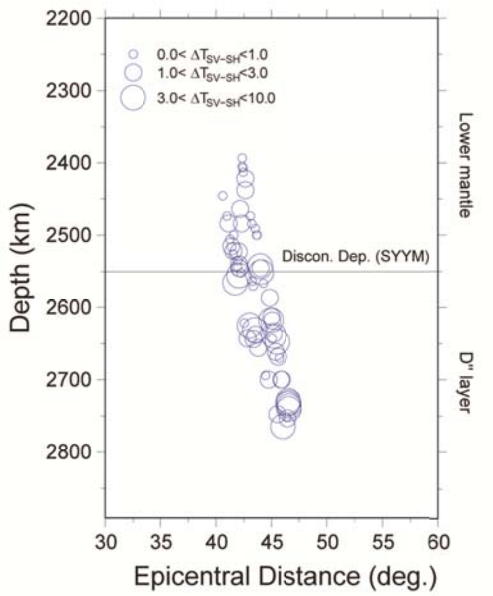

Figure 2. A plot of the observed shear wave splitting (circles) on the depth and epicentral distance of S wave turning point.

References

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