



A new fifth parameter for transverse isotropy

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Kawakatsu et al. (2015) recently proposed a new parameter, η_κ that properly characterizes the incidence angle dependence (relative to the symmetry axis) of seismic bodywaves in a transverse isotropy (TI) system. While the commonly used fifth parameter in global seismology to describe TI system, $\eta = F/(A - 2L)$, has no simple physical meaning, the newly defined parameter, $\eta_\kappa = (F + L)/[(A - L)^{1/2}(C - L)^{1/2}]$ where A, C, F and L denote the Love's elastic constants for TI, measures the departure from the "elliptic condition" when η_κ not equal to unity, and characterizes nicely the incidence angle dependence of bodywaves.

When existing models of upper mantle radial anisotropy are compared in terms of this new parameter, PREM shows a distinct property. Within the anisotropic layer of PREM (a depth range of 24.4-220km), $\eta_\kappa < 1$ in the top half and $\eta_\kappa > 1$ in the lower half. If $\eta_\kappa > 1$, anisotropy cannot be attributed to the layering of homogeneous layers, and thus requires the presence of intrinsic anisotropy (Kawakatsu, 2016).

To further investigate significance of the new parameter for long-period seismology, partial derivatives of surface wave phase velocity and normal mode eigen-frequency for the new set of five parameters are examined. The partial derivative for η_κ is about twice as large as that for the conventional η , indicating that η_κ is more resolved than is usually considered. While partial derivatives for (anisotropic) S-velocities are not so changed, those for (anisotropic) P-velocities are significantly modified; the sensitivity for anisotropic P-velocities is greatly reduced. In contrary to Dziewonski and Anderson (1981)'s suggestion, there is not much control on the anisotropic P-velocities. The significance of η_κ for the long-period seismology has been shown.

While how well the fifth parameter is constrained from data needs to be carefully examined, we now have, at least, a parameter that properly characterizes the TI system. This parameter should be used in future surface wave and bodywave studies of the mantle radial isotropy, rather than the conventional η .

Reference:

- Kawakatsu, H., J.-P. Montagner, and T.-R. A. Song (2015), On DLA's η , in *The Interdisciplinary Earth: A volume in honor of Don L. Anderson*, edited by Foulger et al., PP. 33-38, GSA and AGU.
Kawakatsu, H. (2016), A new fifth parameter for transverse isotropy, *Geophys. J. Int.*, 204, 682-685.