Mismatch between SKS splitting and flow model predictions for densely sampled continental plates challenges our understanding of the structure of the lithosphere and asthenospheric dynamics

*Thorsten W Becker[1], Wanying Wang[1]

1. Institute for Geophysics and Department of Geological Sciences, Jackson School of Goesciences, The University of Texas at Austin

Large numbers of SKS splitting observations and improved surface-wave based models of azimuthal anisotropy have advanced our understanding of how convection is recorded in the asthenospheric upper mantle. However, we are still debating the relative importance of frozen-in to actively forming olivine fabrics, for example, and regional marine studies yield conflicting evidence as to what exactly is going on at the base of the plates. Here, we explore the degree of agreement between regional observations and models of seismic anisotropy and how well those may be matched by first-order convection models. We focus on continental lithosphere, where the continental US has been imaged well by USArray and other experiments. Yet, even there, predictions based on surface wave models do not match anisotropy patterns as inferred from SKS splitting. Moreover, only the simplest flow models predict acceptable fits to seismic anisotropy when we assume that anisotropy originates solely in the asthenosphere. Once higher resolution tomographic models are included, results degrade significantly, questioning the interpretation of seismic velocity anomalies as density, the link between mantle-flow induced anisotropy and seismology, or both. We explore possible ways of explaining the signal with augmented models and offer several explanations of the mismatch between flow models and SKS splitting. One of them is that there is a fundamental gap in our understanding of the role of convection in inducing anisotropy.

Keywords: seismic anisotropy, mantle flow, lithosphere-asthenosphere boundary

©2018. Japan Geoscience Union. All Right Reserved.