Reduced oceanic seismic anisotropy by small-scale convection

J. van Hunen[1] and O. Cadek[2].
[1] University of Durham, UK
[2] Charles University, Prague, Czech Republic

Seismic anisotropy has been proven a valuable tool to determine rheology and flow properties in the Earths asthenosphere. However, the relationship between flow and the nature of seismic anisotropy is complicated and depends on cumulative strain and rheological properties such as dynamic recrystallization, and even simple shear experiments show non-trivial fabric developments (e.g. Zhang & Karato, 1995; Wenk & Tome, 1999; Kaminski & Ribe, 2001). Several studies indicate that the amplitude of seismic anisotropy in the old Pacific is small compared to that in the young Pacific (Nishimura & Forsyth, 1989; Becker et al.,2003; Smith et al., 2004). This suggests that the built-up seismic anisotropy is somehow destroyed during ageing of the plate. Here we examine how small-scale sublithospheric convection (SSC) influences the amplitude fabric under older oceanic lithosphere. SSC has been suggested to occur below Pacific lithosphere older than $\sim$ 70 Ma, although it might locally occur under much younger lithosphere when triggered by inhomogeneities, such as transform faults or melting events (Ballmer et al., 2007).

We investigated the importance of SSC on the disturbance of plate-motion aligned seismic anisotropy in oceanic lithosphere. Therefore, we output from our previous model calculations (van Hunen et al., 2005) the local deformation rate, from which we calculate accumulated strain and fabric using the numerical code D-Rex, provided by Edouard Kaminski (Kaminski, Ribe, and Browaeys, GJI, 158, 744-752, 2004). Our results show that on a 100-km lengthscale, SSC randomly reorientates previously build-up anisotropy over a given depth range. However, when smoothed over lengthscales of 500-1000 km (the typical seismic resolution of surface wave tomography in the Pacific) SSC appears to reduce the amplitude, not the azimuthal direction of anisotropy. These results are similar to the observed anisotropy amplitudes, and suggest SSC as a possible explanation for reduced anisotropy in the older Pacific lithosphere.