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Seismic anisotropy from crust to core: a mineral and rock physics perspective

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Since the early work of Hess and co-works for mantle in the 1960s and Poupinet et al. in 1980s for the inner core, we know that seismic anisotropy is a global phenomenon. Progress in seismology has led to a much more complete image of the Earth's interior in terms of heterogeneity and anisotropy. The interpretation of the seismic anisotropy requires a multidisciplinary effort to unravel the geodynamic scenario recorded in today's seismological snapshot. Progress in mineral physics on the experimental measurement of elastic properties at extreme conditions are now completed by *ab initio* atomic modelling for the full range of temperatures and pressures of the Earth's interior. The new data on the elastic constants of wider range minerals enables more realistic petrology for seismic anisotropy models. Experimental plastic deformation of polycrystalline samples at deep Earth conditions allows the direct study of crystal preferred orientation (CPO) and these studies are completed by *ab initio* atomic modelling of dislocations and other defects that control plasticity. Finally, polycrystalline plasticity codes allow the simulation of CPO reported by experimentalists and the modelling of more complex strain paths required for geodynamic models. The CPO of crustal and mantle rocks from the Earth's surface or recovered as xenoliths, provides a geological verification of the CPOs present in the Earth. The systematic use of CPO measured by U-stage for field studies all over the world for last 40 years has now been intensified in last 15 years by the use of electron back-scattered diffraction (EBSD) to study of CPO and the associated digital microstructure. It is an appropriate time to analysis CPO databases of olivine and other minerals, which represents the work of our group, both present and former members, as well as collaborating colleagues. It is also interesting to compare the natural record as illustrated by our databases in the light of recent experimental results. Information on CPO together with single crystal elastic constants and the equation of state allow the modelling of seismic anisotropy due to plasticity at any PT condition, and the connection with geodynamic processes related to large-scale flow in the deep Earth.

Keywords: seismic anisotropy, upper mantle, inner core, plastic deformation, crystal preferred orientation