The elastic properties of $MgSiO_3$-akimotoite at transition zone pressures

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Seismic wave velocities in the Earth's transition zone between 410 and 660 km depth are poorly matched by mineral-based models, especially near the base. Mineralogical models of a peridotitic bulk mantle lithology fail to reproduce the seismic velocity profile of reference models and result in slower wave velocities mainly due to the abundance of majoritic garnet. A lower average mantle temperature at the base of the 660 km discontinuity due to the presence of stagnating cold slab material may be a reason for this velocity difference. Lower temperatures relative to the mantle geotherm, however, would stabilize the low-temperature mineral akimotoite, which would partially replace majoritic garnet. Akimotoite is a $MgSiO_3$ polymorph stable between 20 and 25 GPa and 900 to 2200 K. The elastic properties of $MgSiO_3$-akimotoite have been studied previously using ultrasonic interferometry and were found to increase the modelled wave velocities when incorporated in the mineralogical models of the transition zone [1]. Seismic observations, in addition, show lateral heterogeneities around the 660 km-discontinuity that could be attributed to phase transitions involving akimotoite [e.g. 2] as well as anisotropic features that are suggested to be due to the presence of akimotoite [e.g. 3-4]. The interpretation of these heterogeneities as well as the origin of the anisotropy in the lower mantle transition zone requires knowledge of the elastic properties and anisotropic behavior of akimotoite at high pressures.

In order to obtain the full elastic tensor of $MgSiO_3$-akimotoite, two single-crystals of this mineral were studied in a diamond anvil cell by means of Brillouin spectroscopy and single-crystal X-ray diffraction up to pressures of the transition zone. The results allow a direct comparison between the elastic parameters obtained from two different acoustic velocity methods; ultrasonic interferometry and Brillouin spectroscopy. The variation of the elastic tensor and the anisotropy of akimotoite up to its stability field near the 660 km-discontinuity will be discussed.

[1] Zhou et al. (2014) *PEPI* **228**, 97-105. [2] Ai et al. (2003) *EPSL* **212**, 63-71. [3] Wookey et al. (2002) *Nature* **415**, 777-780. [4] Nowacki et al. (2015) *Geochem. Geophys. Geosyst.* **16**, 764-784.