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Elastic wave velocities of Al-bearing stishovite at high P and T
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Like continental crust, mid-oceanic ridge basalts and sediments are enriched in Silicon. It has been suggested that subduction processes provide a way of enriching the mantle with silica. Above 10 GPa, SiO_2 transforms to stishovite with a tetragonal rutile structure (space group $P4_2/mnm$), which is believed to be a major mineral of mid-oceanic ridge basalts subducted to the mantle transition zone [1]. Previous studies have shown that stishovite has a relatively high-density compared to other constituent minerals of subducted slabs, and could generate chemical and density heterogeneities in the deep mantle. For this reason, numerous studies reported the physical properties of pure stishovite (see [2], and references therein). However, in the subduction context, stishovite can contain up to 2.5 wt% Al_2O_3 in dry systems [3] and up 9 wt% Al_2O_3 in hydrous systems [4]. Therefore stishovite is proposed to be an important carrier of Al and H_2O into the transition zone and lower mantle. The incorporation of even small amounts of Al and its possible coupling with oxygen vacancies can influence the stability, density and compressibility of SiO_2[5-7].

The pressure and temperature dependences of the elastic properties of stishovite + 1 to 6 wt% Al_2O_3 were examined *in situ* up to 24 GPa and 1700 K by using a Kawai-type multi-anvil press apparatus coupled with synchrotron X-ray diffraction and ultrasonic interferometry. The collection of P-V-T-V_P-V_S data simultaneously provided a strong constraint on the pressure, temperature and Al-content dependences of velocities and elastic properties of Al-stishovite. Generally, we found that sound velocities of P- and S-waves are substantially slower for SiO_2 + only 1wt% Al_2O_3. Thermoelastic data are extrapolated to higher P, T and Al-content and used to directly estimate density and velocity profiles for various composition and temperature profiles. Our results are discussed in regards with the structure and composition of slabs subducted to the depths of the mantle transition zone and lower mantle.

References:

[1] Irifune et al., Earth Planet. Sci. Lett. 126(1994) 351-368.
[2] Andrault et al., Science 282(1998) 720-724.
[3] Liu et al., Phys. Chem. Miner. 33(2006) 711-721.
[4] Ono, Journal of Geophysical Research B: Solid Earth 103(1998) 18253-18267.
[5] Lakshtanov et al., Am. Miner. 92(2007) 1026-1030.
[6] Lakshtanov et al., Phys. Chem. Miner. 32(2005) 466-470.
[7] Bolfan-Casanova et al., Phys. Earth Planet. Inter. 174(2009) 70-77.

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