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Si diffusion in single crystal of MgSiO3 perovskite

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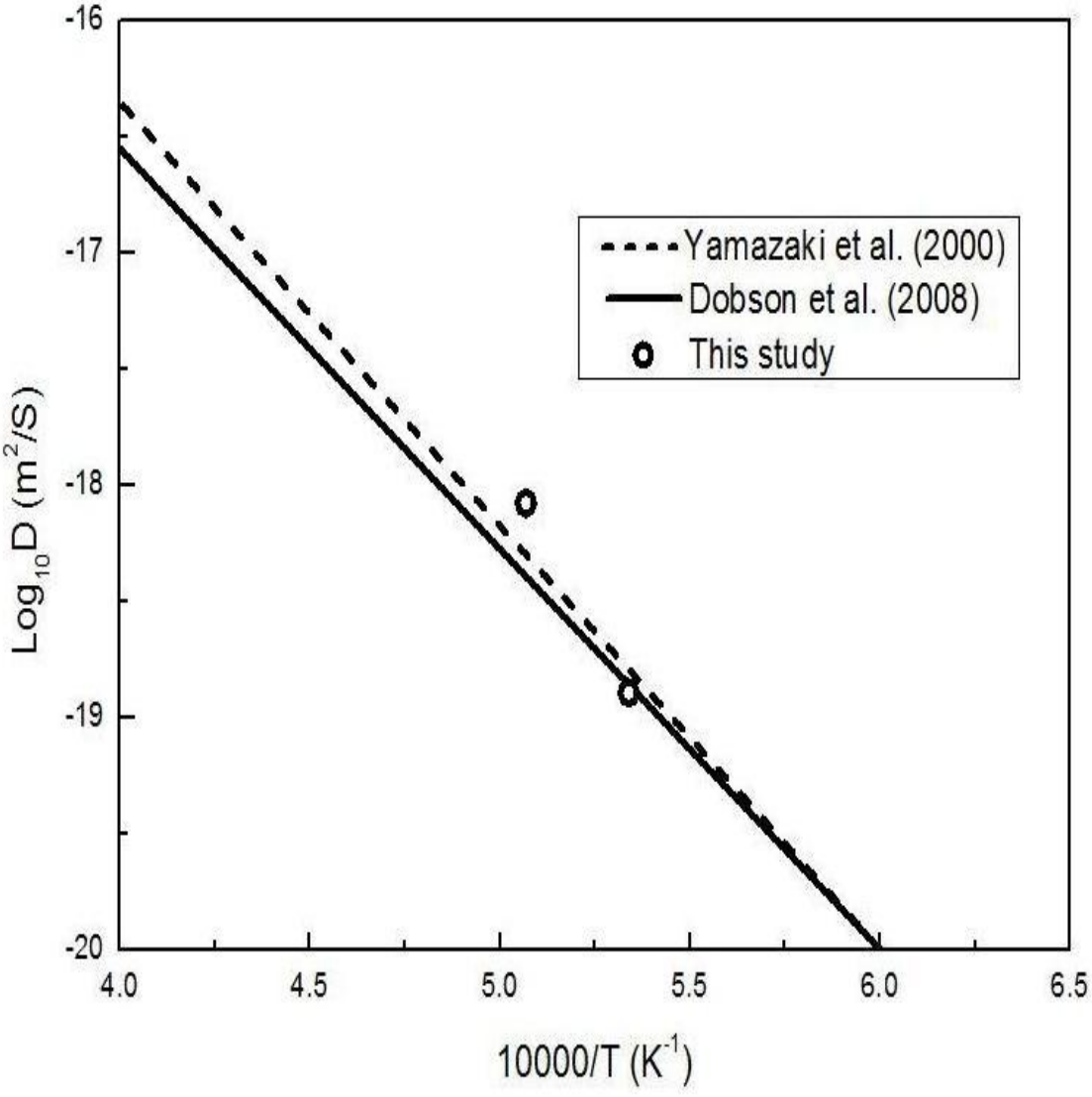

Fig.1 Diffusion coefficients in $MgSiO_3$ perovskite at 25

Diffusion creep (Nabarro-Herring or Coble creep) may dominate in the most part of lower mantle (Karato et al., 1995). In most silicates, silicon is the slowest diffusing species, and therefore, the diffusion of silicon is likely to control the vicosity of the lower mantle (Houlier et al., 1990; Bejina and Jaoul, 1996). In the earth's lower mantle, magnesium silicate perovskite is the dominant material and it may exceed 85% of the volume (Stixrude et al., 1992). Therefore, measurement of Si diffusion coefficient is important for understanding the dynamics of the lower mantle. Yamazaki et al. (2000) and Dobson et al. (2008) investigated Si diffusivity in $MgSiO_3$perovskite using polycrystalline samples. In this study, Si self-diffusion coefficients in single crystals of $MgSiO_3$ perovskite were measured under lower mantle conditions.
Single crystals were synthesized at the conditions of 25 GPa and 1500 degree C using Kawai-type multi-anvil high-pressure apparatus, orientated by precession X-ray camera and ^{29}Si enriched layer was coated by pulsed laser depostion (PLD) on polished surface. Diffusion annealing experiments were conducted at pressure of 25 GPa and temperatures from 1400 degree C to 1800 degree C. The diffusion profiles were obtained by secondary ion mass spectrometry (SIMS).
The diffusion coefficients are identical within error to previous results. There is no siginificant different for Si diffusion in single crystal of perovskite from polycrystal perovskite (Fig.1). The results agree with the conclusion that the effective diffusion of silicon in perovskite is almost represented by the lattice diffusion if the grain size is larger than a few tens micrometers (Yamazaki et al., 2000). In addition, there seem to be no significant orientation dependence.

Keywords: Si diffusion, perovskite, lower mantle