The 382th Geodynamics Seminar

Role of Mg-O grain-boundary diffusion in rheology and grain-growth in the Earth's mantle

Dr. Yu Nishihara (Associate Professor, GRC)

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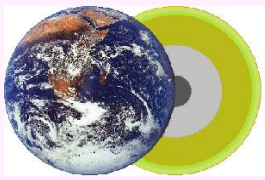

EHIME UNIVERSITY GRC GEODYNAMICS RESEARCH CENTER

Abstract

Material and heat transports in the Earth highly depends on rheology and grain-growth kinetics of the constituent materials. Although rheology and grain-growth in single phase aggregate have been studied extensively, knowledge of those in multi-phase system is still limited. It has been suggested that Mg-O grain-boundary diffusion plays important role both in rheology and grain-growth. Recently, our group reported Mg-O grain-boundary diffusion coefficients in forsterite and $MgSiO_3$ perovskite (Maruyama et al., 2013; Nishi et al., 2013). We have compared theoretical model using our Mg-O grain-boundary diffusion data and available rheological and grain-growth data, and examined importance of these mechanisms. Flow-law were calculated for Mg-O grain-boundary diffusion creeps accompanied by reaction at forsterite-enstatite phase boundary (upper mantle) or accompanied by grain-growth of periclase (lower mantle) using Coble's(1963) equation and results by Maruyama et al. (2013) and Nishi et al. (2013). The derived flow-law for the upper-mantle did not show realistic strain rate. On the other hand, the derived flow-law for the lower-mantle shows faster strain-rate than that by Si lattice diffusion creep that was assumed in Xu et al. (2011) and the mechanism is a possible candidate for the dominant deformation mechanism in the most part of lower mantle. Grain-growth law was calculated for the lower mantle assemblage $MgSiO_3$ perovskite-periclase system using Ardell's (1972) theory and Nishi et al.'s (2013) results. Derived grain-growth law was generally consistent with the grain-growth data in $MgSiO_3$ + MgO system reported by Yamazaki et al. (1996). Yamazaki et al.'s results can be explained by initial rapid growth from metastable texture and subsequent normal grain-growth which is rate-limited by Mg-O grain-boundary diffusion. Based on this interpretation, grain-size in the lower mantle is estimated to reach several hundred micrometer by 10^6 years.

詳細は当センターホームページ：http://www.ehime-u.ac.jp/~grc/をご覧ください
問い合わせ先： 出倉 春彦（TEL:089-927-8408, e-mail:dekura@sci.ehime-u.ac.jp）