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Effect of Water on Grain Growth in Perovskite + Ferropericlase Assemblage

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The absence of seismic anisotropy in the Earth's lower mantle suggests that deformation in that region is governed by diffusion [1]. In such a case, the rate of creep, and thus viscosity, should be proportional to the grain size. Previous experiments performed on $MgSiO_3$ perovskite + periclase assemblage have shown that the grain growth kinetics follows a power law with an extremely large exponent around 11 [2]. Such a parameter is explained by the mutual intergrowth texture of the perovskite + periclase assemblage which inhibits grain growth by a Zenner pinning effect. Moreover, such results suggest that the grain size in the lower mantle is almost constant [3]. However, there are traces of water inside the Earth which are likely to act as a flux and this effect has never been investigated.

In this study we investigated the effect of water on the Ostwald ripening of the post-spinel assemblage. We used the multi-anvil press at 24 GPa and different temperatures of 1400 to 1800˚C. The starting material was pre-synthesized ringwoodite made from San Carlos olivine and loaded into Pt capsules. After recovery, the samples were analyzed by SEM and FTIR.

The results show that compared to the previous study made from forsterite starting material [2] the grain size of post-spinel made from ringwoodite is smaller. Also the grain sizes increase with water content, as theoritically expected.

Thus, it appears that the effect of water on the viscosity of the lower mantle is not very important, which is a very surprising result.

References : [1] Karato S., S. Zhang, H.R. Wenk, 1995, *Science* 270: 458-461. [2] Yamazaki D., T. Kato, E. Ohtani, M.Toriumi, 1996, *Science* 274: 2052-2054. [3] Solomatov V.S., R.El-Khozondar, V. Tikare, 2001, *Phys. Earth Planet. Int.* 129: 265-282.