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Iron diffusion in mantle olivine under steep temperature gradient

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Laser-heated diamond anvil cell (LHDAC) has been generally used as a major method in which we can generate high temperature and pressure conditions of the Earth's interior. However, a strong temperature gradient is formed in the sample, because only a local region can be raised to high temperature by the laser heating technique. The Soret effect is known as a phenomenon of chemical diffusion induced by a temperature gradient, which causes a change of homogeneous material to heterogeneous chemistry. The Soret diffusion in liquids has popularly been studied and is fast, while that in solids and its pressure dependence have not been well examined because the Soret effect is relatively slow and more complex in solids than in liquids. Moreover, the investigation of Soret effect in solids under high temperature and pressure may be helpful to understand the possible diffusion in the Earth.

In this study, we studied the material experienced a steep temperature gradients using LHDAC and $(Mg_{0.89},Fe_{0.11})_2SiO_4$ San Carlos olivine as the starting material. The recovered samples were examined using a Field Emission-Scanning Electron Microscope (FE-SEM) and analyzed Mg-Fe interdiffusion. Chemical heterogeneity formation due to temperature gradient was observed in different experimental conditions such as temperature gradient, heating duration and phase transition. We will report the effect of these parameters on Soret diffusion in solid.

Keywords: LHDAC, Soret effect, diffusion in solid