

In-situ X-ray diffraction measurement of growth kinetics of reaction rim at high pressures

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Diffusion rates of elements in minerals provide important constraints for understanding many physical and chemical processes in the Earth's interior, including mantle rheology and chemical transportation. Therefore, many researchers showed the experimental studies on the growth kinetics of reaction rims between minerals, which are often controlled by diffusion of elements. Most of the previous studies succeeded to determine the rim growth kinetics based on the direct measurement of the thickness of reaction layers of recovered samples. However, it is difficult to obtain the precise growth kinetics in this method due to the small uncertainty of temperature and water contents during each experiment.

Here we use in situ X-ray measurements in conjunction with a multi-anvil apparatus to obtain the precise kinetic data of the rim growth of MgAl_2O_4 spinel between MgO periclase and Al_2O_3 corundum. Time resolved X-ray diffraction patterns enable us to obtain the information with the constant temperature, pressure, and water contents.

We succeeded to obtain the time-resolved X-ray diffraction data during the rim growth of MgAl_2O_4 spinel. However, the obtained growth kinetics contains large uncertainty because of the grain growth of the sample minerals due to high water contents. Further experimental improvement would be required to obtain the precise growth rate of the reaction rims.

Keywords: rim growth kinetics, mantle, multi-anvil apparatus