구두1-6

# Modeling for intercrystalline isotope diffusion

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Stable isotope exchange between coexisting minerals can take place during cooling of a closed system, followed by isotopic diffusion through minerals. The result of stable isotope diffusion depends on the temperature, time, diffusion coefficients, fractionation factors, grain sizes and abundances of mineral phases. Since these factors can be determined by experiments and petrological studies, the cooling history of the system can be modeled.

To model isotopic exchange between minerals and retrograde intra-crystalline diffusion in a closed system, it is assumed that 1) isotope concentration at grain boundaries is considered to be homogeneous at any points of grain boundaries, 2) mass flux of isotope is preserved (thus, net flux is zero), 3) concentration gradient at the grain surfaces leads to a solid-state isotope diffusion through individual grains, and 4) diffusion coefficients of minerals and isotopic concentrations at grain boundaries are changed with decreasing temperature (Eiler *et al*., 1994; Jenkin *et al*., 1994). This process continues until the system cools down to the diffusive closure temperatures of minerals.

Results of modeling well reproduce concentration profiles observed in terrestrial rocks (e.g., Bonamici *et al*., 2011). The model is applied to refractory inclusions in extraterrestrial rocks to reproduce isotopic distributions in coexisting minerals, which could constrain cooling history of the inclusions in the early Solar System.