Experimental determination of oxygen diffusion rates in garnet: A preliminary study

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Garnet is one of the best-known minerals in the Earth and is particularly notable for its commonality in a wide range of environments. Garnet crystals commonly have concentric growth chemical and isotopic zoning that can be related to variations in pressure, temperature, and chemical composition. Particularly, zoning in the oxygen isotopic composition can record infiltration of external fluids in metamorphic or hydrothermal systems. In order to correctly interpret oxygen isotopic signatures measured in natural samples and to constrain rates and timescales of fluid-rock interaction processes into the crust, it is mandatory to know the oxygen diffusion rate in garnet.

Despite the importance of garnet as a source of information about P-T-t-X_{fluids}, oxygen diffusivity in this mineral is poorly constrained. We present preliminary results that aim to extand the knoweldge about oxygen diffusion in garnet as a function of chemical composition, temperature, oxygen fugacity, and water activity. We performed high-pressure hydrothermal experiments using different garnet compositions (*i. e.*, YAG, pyrope, and grossular). Garnet cubes were embedded into a matrix made of fine-grained powder of the same garnet plus 20% ^{18}O-enriched water. Graphite buffer was used for experiments with pyrope and YAG, whereas Re-ReO buffer was used for experiments with grossular. Experiments were performed in a piston cylinder apparatus at T > 900°C and P > 1 GPa. We also performed 1atm dry experiments in a gas-mixing furnace at temperatures as high as 1400°C using YAG. Garnet cubes were coated with a YAG+corundum powder; corundum was added in order to constrain silica activity.

Due to the expected short length of diffusion profiles, the recovered crystals were analysed by depth profiling using the SHRIMP ion microprobe. Mixing and edge effects were investigated in the experimental charges as well as in garnet crystals not annealed at experiemental conditions and coated with a thin-film of ^{18}O-enriched olivine. The measured diffusion profiles were fitted to the diffusion equation using least squares regression.