Experimental calibration of oxygen diffusion rates in YAG garnet

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Garnet is commonly encountered in a variety of rocks and tectonic settings and its chemical and isotopic zoning is regularly used to unravel the *P-T-t-*X_{fluids} evolution of the crust. However, the correct interpretation of oxygen isotopic signatures measured in natural rocks as well as the understanding of timescales and rates of fluid-rock interaction processes require the knowledge of oxygen diffusion rates in garnet, which are yet poorly constrained.

High-*P* dry experiments were performed in a piston cylinder apparatus at (*i*) *T*=1050-1600°C (*P*=1.5 GPa) and (*ii*) *T*=1500°C (*P*=2.5 GPa). YAG cubes were annealed in Pt capsules containing a matrix made of graphite powder mixed with fine-grained YAG+corundum powder enriched in ^{18}O. Corundum was used to constrain silica activity. High-*P* H_2O-saturated experiments were also done at (*i*) *T*=900-1050°C (*P*=1.5 GPa) and (*ii*) *T*=900°C (*P* =1.0 GPa). YAG cubes were annealed together with a matrix made of fine-grained YAG+corundum powder and 20% ^{18}O-enriched H_2O. One experiment at *T*=900°C (*P*=1.0 GPa) was done using a pyrope cube embedded into pyrope powder plus ^{18}O-enriched H_2O. Finally, 1 atm experiments were performed in a gas-mixing furnace at *T*=1500-1600°C by using Ar flux to avoid exchange of oxygen with the atmosphere. YAG cubes were coated with YAG+corundum powder enriched in ^{18}O.

The recovered crystals were analysed using the SHRIMP ion microprobe either in traverse or depth profiling mode. Mixing and edge effects were investigated in the experimental charges and in garnet crystals coated with ^{18}O-enriched olivine thin films not annealed at experimental conditions.

Results obtained for YAG and pyrope at 900°C were similar. Hence, YAG was used to investigate diffusion in a wider *P-T* range due to its larger stability. The obtained results suggest diffusion coefficients up to two orders of magnitude faster than those available in the literature. Results obtained at different *P* suggest no significant effects on the diffusion rates. Similar diffusion coefficients were obtained from experiments performed at high-*P* and at 1 atm in different experimental conditions.