

Investigation of hydrogen isotopes in garnet crystals from the Kara Mine, Tasmania

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Few studies have explored in situ variations in δD in garnet [1]. In this work, δD is measured via Nano Secondary Ion Mass Spectrometry in core-rim traverses within garnet crystals from the Kara Mine, Tasmania. The Kara Mine is a skarn that is mined for tungsten and iron. The mine has a limestone and marble protolith that was intruded by Devonian granitoids. Garnet is abundant throughout the mine and displays compositions of >95% andradite. This work investigates how water behaves in garnet by comparing profiles of water concentration and hydrogen isotopes. The garnet crystals display water concentrations that vary from up to 6,000 ppm in the core down to 1,500 ppm towards the rim. These concave-down profiles are suggestive of diffusion of water out of the garnet grains. The δD values range from approximately -150 to -200‰ with relatively large estimated uncertainties, with no systematic trends within the core-rim traverses. If diffusion has occurred, an increase in δD would be expected towards the garnet rims due to diffusive fractionation of D vs. H. The absence of this observation suggests that either the water concentration profiles are due to growth zoning and are not a product of diffusion, or that D-H exchange is rapid enough that the D/H has reached equilibrium across the entire crystal. In this latter scenario, the water gradient is preserved metastably due to zoning in other trace element defects. It has been previously suggested that hydrogen mobility in andradite is much more rapid than for other nominally anhydrous minerals and is especially faster than other garnet compositions [2]. Other clues, including major and trace element compositions, can help distinguish between potential causes for the observed profiles. This study aims to explore all possible explanations for the observed profiles and will also discuss the implications on future applications of in situ measurements of δD in garnet.

[1] Roskosz, Deloule, Ingrin, Depecker, Laporte, Merkel, Remusat, and Leroux (2018), *Geochimica et Cosmochimica Acta* 233, 14–32.

[2] Zhang, Ingrin, Depecker, and Xia (2015), *American Mineralogist* 100, 1400–1410.