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Grossular-almandine replacement and growth experiments

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High resolution textural and chemical imaging of garnet is increasingly utilised by petrologists. As a result, the sharp reaction interfaces that are indicative of garnet-garnet replacement via interface coupled dissolution-reprecipitation (ICDR) are becoming more frequently identified in natural samples. The geological interpretation of natural garnet that have undergone ICDR is limited by the fact that we know very little about the timescales and driving forces associated with ICDR in garnet. Further, it remains unclear under which conditions epitaxial growth of new garnet rather than ICDR should be expected. To address this, we are conducting a time-series of piston cylinder experiments at 600 °C and 0.8 GPa with natural grossular garnet ($Ca_3Al_2Si_3O_{12}$) starting material. For each experiment the grossular is reacted with a SiO_2-Al_2O_3-Fe-Fe_3O_4 powder and a H_2O fluid of varying $FeCl_2$ molality. At equilibrium the solid assemblage is predicted to contain a grossular-almandine garnet solid solution. For each individual time series, we vary the amount of dissolved $FeCl_2$ added to the experiment between < 0.001 to 2 M, thereby varying the initial degree of almandine saturation (i.e., the reaction overstepping) in the fluid. The aim here is to establish the key parameters that govern the mechanism of garnet reaction. Further, we aim to quantify the relationship between reaction progress and the initial overstepping at the grossular-fluid interface.