ELEMENT PARTITIONING AT A PROPAGATING REACTION FRONT: EXPERIMENT AND THEORY

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Equilibrium element partitioning between phases is the basis for many applications in petrology and geochemistry. We investigated Mg/Al partitioning by growing magnesio-aluminate spinel ($MgAl_2O_4$) at periclase (MgO) - corundum (Al_2O_3) contacts. Experimental conditions were 1 bar confining pressure and 1350 °C, at run durations of 5 to 160 h. The spinel forms polycrystalline reaction rims, which grow by the interdiffusion of Al^{3+} and Mg^{2+} In accordance with the phase diagram, spinel is close to stoichiometric with X_{Al} (atomic Al/(Mg+Al) ratio) of about 0.66 at the periclase-spinel contact and it becomes successively more aluminium-rich towards the corundum. Interestingly, at the spinel-corundum interface, the X_{Al} increases with increasing run duration. It is 0.66 in short time runs (5 h), and it is 0.69 after 160 h. This reflects a successive approach towards local equilibrium and corresponds to a decrease of the jumps in the Al_2O_3 and MgO chemical potentials across the propagating reaction interface. This evolution is due to the finite mobility of the spinel-corundum interface. A local driving force is required for interface motion. In this case it is provided by the free energy jumps of the MgO and Al_2O_3 components associated with their transfer across the reaction interface. This effect is pronounced during the initial, interface reaction controlled stages of the reaction and diminishes at later stages, when the reaction becomes diffusion controlled. From this observation the interface mobility, a key parameter in kinetic modelling, can be quantified.