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# Minor element effects on the partitioning of Rare Earth Elements (REEs) between pargasitic amphibole and melt

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The effect of substituting titanium and fluorine (F) for $H_2O$ on rare earth elements (REEs) partition coefficients betweensynthetic pargasite, clinopyroxene and melt has been determined at 10 kbar and 950 and 1050ºC in the system $K_2O$-$Na_2O$-$TiO_2$-$Al_2O_3$-CaO-MgO-$SiO_2$-(OH, F) for molar F/(F+OH) from 0 to 1, and $TiO_2$ in the melt from 0 to 2.5 wt%. Experiments at 950°C crystallized pargasite (OH, F), with some also containing clinopyroxene and accessory titanite coexisting with melt, while only F-rich pargasite, clinopyroxene and melt were found in the experiments at 1050°C. There is a strong negative correlation between F and REE pargasite/melt partition coefficients, whereas Ti positively correlates with the REE partition coefficients, requiring the two effects to be deconvoluted by varying the starting compositions. The effect of F can be ascribed to REE-F bonding stabilizing REE in the melt rather than to the F/OH in the pargasite, since a similar effect is observed in the clinopyroxene/melt partition coefficients. This implies that F would influence mineral/melt REE partition coefficients generally.

Both the pargasite and clinopyroxene REE partition coefficients are well fit by the lattice strain model, with maxima in the parabolas near Dy. Partition coefficients were also obtained for Y, Rb, Sr, Ba, Zr and Hf, and Nb and Ta. Rb, Sr and Ba are significantly less incompatible in pargasite than clinopyroxene. The partition coefficients for Hf are greater than those for Zr, whereas those of Nb and Ta are similar.