Melt composition effect on the FRTM and HFSE partitioning between cpx and silicic melts

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Clinopyroxene (cpx) plays an important role in controlling trace elements in magmatic systems. Although it is well known that cpx/melt partitioning of REE, Sr and Ti is related to melt structure[1], melt composition effect on partitioning of the first-row transitional metals (FRTM) (Sc, V, Cr, Mn, Co, Ni, Cu and Zn) and HFSE (Nb, Ta, Zr and Hf) between cpx and silicic melts is still not clear.

Trace elements partitioning experiments between cpx and silicic melts (66-69 wt% SiO_2) was performed with a high-temperature furnace at 1atm and 1080-1100 ºC. Run products consist of diopsidic cpx coexisting with silicic, aluminous, and alkaline melts with NBO/T ranging from 0.09 to 0.21. $^{cpx/melt}D_{REE}$ (e.g., D_{La} = 0.31-0.40, D_{Sm} = 1.64-2.22, D_{Yb} = 1.59-2.00), D_{Sr} (0.20-0.32) and D_{Ti} (0.60-0.88) are elevated relative to the results from cpx-basalt system, which is consistent with previous studies [1, 2].

D_{Sc} (3.90-6.13), D_{Cr} (11-36), D_{Mn} (1.83-2.97), D_{Co} (3.02-5.42), D_{Ni} (13-48), D_{Cu} (0.11-0.23) and D_{Zn} (0.50-0.97) increase with NBO/T of the melt, while no correlation is observed between ^{IV}Al of cpx and $^{cpx/melt}D$. A strong correlation between molar $Ca^{2+}/(M^{+}+M^{2+})$ of the melts and optimum D (D_o) for Sc, Cr, Co has been observed. These observations indicate melt composition can affect $^{cpx/melt}D_{FRTM}$. In contrast to FRTM, D_{Nb} (0.01-0.03), D_{Ta} (0.03-0.08), D_{Zr} (0.20-0.35) and D_{Hf} (0.37-0.53) are within the range from literature and show no correlations with NBO/T, indicating negligible effect of melt composition.

Knowing cpx/melt partition coefficients of FRTM and HFSE may help us better understand compositional evolution of felsic magma with cpx crystallization, and furthermore, related crust-mantle processes from a new perspective.

[1] Huang et al. (2006) AM. 91, 1385-1400. [2] Gaetani (2004) CMP. 147, 511-527.