

# Alkali activities in silicate melts

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We have conducted a series of experiments at ambient pressure and temperatures of 1400-1500°C in order to determine the activity coefficients of a number of moderately volatile elements in silicate melts as a function of melt composition. Experimental procedure was similar to that described previously [1]. Each experiment contained five samples, each with a unique bulk composition in the CMAS system, and a sixth with a composition on the join  $X_2O$ - $SiO_2$  (where X was either Li, Na or K). Samples were suspended in a vertical furnace along with a source of Li, Na, or K. Inclusion of the  $X_2O$ - $SiO_2$  bulk composition allows us to couple our experimental results with thermodynamic models of the relevant alkali metal oxide-silica binary melts [2] and define absolute activity coefficients for alkali components in the synthetic CMAS melts.

Our results suggest that  $LiO_{0.5}$ ,  $NaO_{0.5}$  and  $KO_{0.5}$  activities in the melt are not affected by degree of melt polymerization, and indicate that Al-Li, Al-Na and Al-K interactions are not of great importance in these synthetic melts. At fixed alkali activity we find that all of the alkali ions we examined are most soluble in  $SiO_2$ -rich compositions. Na solubilities measured in this study are in excellent agreement with O'Neill, 2005 [1]. On a molecular basis, Li, Na and K exhibit virtually identical activity-composition dependences. Finally, at fixed  $LiO_{0.5}$ ,  $NaO_{0.5}$  and  $KO_{0.5}$  activities, the concentrations of these components in silicate melts with identical bulk compositions increases with decreasing  $fO_2$ .

Our findings imply that crystal-melt partitioning of alkali ions is only weakly sensitive to melt composition.

[1] O'Neill (2005) *Am. Min.* **90**, 497-501. [2] Romero-Serrano, A. *et al.* (2005) *J. Am. Ceram Soc.* **88**, 141-145.