

Thermal Separation as an Alternative to Centrifugation for Two-Liquid Partitioning Studies

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Determining experimental partition coefficients in two-liquid systems is challenging, partly because completely separating immiscible phases is difficult^[1]. Sufficient phase separation can lead to cross-contamination between phases during trace element analysis that mute the measured partition coefficients. This is particularly challenging for low viscosity melts, such as fluorides, where quench effects complicate the textural interpretation of experimental run-products^[1]. High temperature centrifugation can overcome these problems^[2], however, such equipment is not widespread. We propose an alternative approach using a vertical tube furnace, a common feature of experimental petrology laboratories.

Our exploratory experiments have employed the small (<10 °C/mm) thermal gradients intrinsic to a vertical tube furnace to separate REE-doped immiscible fluorosilicate-silicate melts via thermodiffusion (Fig. 1). We employed starting compositions from [1], allowing direct comparison to previous work. Preliminary results indicate the fluorosilicate phase concentrates to the hot end of the capsule, and liquidus fluorite resides within the fluorosilicate phase (Fig. 1). Importantly, the small thermal gradients used do not induce significant major-element gradients internal to each melt. Work is ongoing to determine trace element compositions of each phase, confirm the timescales required to achieve steady-state, and extend the range of studied melt compositions.

Fluorosilicate-silicate REE partition coefficients (D_{FM-SM}^{REE}) obtained from well separated melts where cross-contamination during analysis can be avoided, will provide new constraints on genetic models of A-type granite REE deposits, such as Strange Lake, QC, Canada. Strange Lake contains evidence for an immiscible fluoride melt hosting >40 wt% REEs that may be important to ore formation^[3]. Existing values of (D_{FM-SM}^{REE}) do not explain the formation of such a REE-enriched melt, motivating further studies and technique development, such as that proposed here, to improve our ability to probe these systems.

[1] Yang, L., van Hinsberg, V. J. (2019), *Chemical Geology*, 511, 28-41.

[2] Veksler, I. V. et al. (2002), *GCA*, 66, 2603-2614

[3] Vasyukova, O., Williams-Jones, A. E. (2014), *GCA*, 139, 110-130.

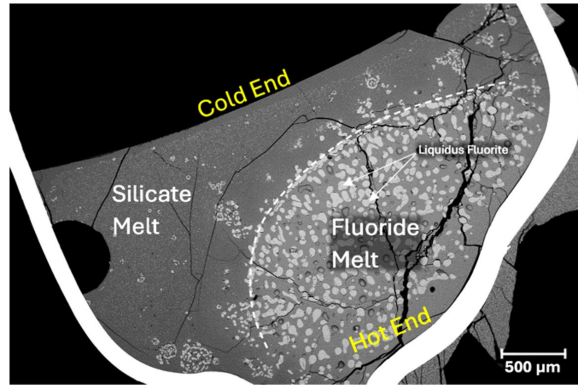


Figure 1: FM-SM-6, 1100 °C, 8.4 °C/mm, showing separation of immiscible fluorosilicate and silicate melts.