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Reassessing volatile and trace element mobility at Mount St. Helens (2004-2008) from amphibole and melt inclusion geochemistry

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Volatile exsolution is an improtant process in volcanic systems. Prior studies have argued mineral geochemistry preserves evidence of volatile element mobility, based on enrichments and depletions inconsistent with mineral/melt partitioning. Utilizing amphibole and amphibole-hosted melt inclusions, the goal of this study is to better understand the processes by which Li and select trace elements are coupling with magmatic volatiles F and Cl during transport through the Mount St. Helens magmatic system associated with the eruption of 2004-2008. To reassess these processes, the trace elements and metals in amphibole are compared to eruption dates, P and T of crystallization, structural data, experimental and published parition coeffients. We propose an updated model that incorporates all available mineral data from this eruption.

Comparing amphibole chlorine contents to T and P reveals two trends, with Cl both increasing and decreasing relative to changes in T and P. With respect to the amphibole phenocrysts, Cl abundances compared to Zr, Sn, Zn and REE also reveal two trends. In contrast, Li is not correlated to other trace elements in amphibole. In the melt inclusions Zn, Sr, and Y are broadly correlated to Li.

Incorporating these results with mineral-melt and melt-fluid literature data, suggests that Li and Cu, elements previously thought to exsolve at depth and partition into a fluid phase as the magma decompresses, are likely to stay in the melt. Similarly, chlorine behaves as an incompatible element in this system. Thus, trace elements and metals correlating to Cl will behave similarly. Although fluorine plays a critial role in stabalizing amphibole at lower pressures and temperatures in this system, it does not appear to play a critical role in the potential mobility of trace elements and trace metals.