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Tin Partitioning Between Fluid and Melt: In Situ Observations Using Hydrothermal Diamond Anvil Cells and Synchrotron X-ray Fluorescence

PILAR VALSERA MORENO[1], MARION LOUVEL[2], HANNAH KOPPETZ-MITRA[1], DARIA DIAGILEVA[1], ANGELIKA D. ROSA[3] AND CARMEN SANCHEZ-VALLE[1]

[1]University of Münster
[2]ISTO, UMR 7327, Univ Orléans, CNRS, BRGM, OSUC
[3]European Synchrotron Radiation Facility

The mobility of tin (Sn) in magmatic-hydrothermal systems is a key factor in understanding the formation of tin deposits. Yet, the processes governing its partitioning between granitic melts and fluids remain poorly constrained. This study investigates the partitioning behavior of tin between a granitic melt and coexisting fluid, employing synchrotron-based in situ experiments in a hydrothermal diamond anvil cell (HDAC). Most experimental studies on Sn partitioning rely on quenched samples, where rapid cooling may alter phase equilibria and metal distribution. Additionally, post-experimental treatment of run products, such as rinsing capsules with acidic solutions, may redissolve adsorbed tin from the capsule walls and artificially alter measured Sn concentrations [1], [2] [3]. In contrast, in situ approaches provide direct observations of metal behavior at relevant P-T conditions, minimizing post-experimental modifications, although the direct data remain scarce [4].

Here, we address this gap of knowledge by utilizing the HDAC in conjunction with Synchrotron X-ray fluorescence (XRF) to directly probe the local distribution of tin between coexisting granitic melts and saline aqueous fluids at magmatic-hydrothermal conditions (< 890 °C and 10 kbar). These experiments reveal a higher affinity of tin for the silicate melt phase under oxidizing conditions, as well as the effect of temperature and salinity on the partition coefficients. The implications of these results for the extraction of tin from magmatic intrusion and the tin budget of magmatic fluids in ore-forming environments will be discussed.

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