# Diffusion of Cu, Mo, and W in hydrous granitic melts with implications for the formation of porphyry deposits

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Diffusivity in silicate melt is a crucial parameter in determining the efficiency of metal scavenging from melt to enriched agents such as hydrothermal fluid or sulfide. We have experimentally investigated the diffusivities of three important metals (Cu, Mo, and W) in granitic melts with $H_2O$ contents in the range of 0-5 wt%.

Diffusion experiments using two different designs, diffusion couple and diffusion-in (with $Pt_{95}Cu_5$ or Mo sheet as the source of metal), were carried out at 700-1600°C and 0.15-1 GPa in piston-cylinder apparatus and cold-seal vessel at USTC. The diffusion profiles preserved in quenched glasses were measured with LA-ICP-MS and fitted with error function curves. The effects of temperature, $H_2O$ content, and pressure on Cu, Mo and W diffusion were quantified and modeled. The obtained Cu diffusivity is in good agreement with a previous study using a different approach ($Cu_2S$ dissolution). The observed diffusivity trends are consistent with univalent Cu and hexavalent Mo and W in the melts.

We find no significant difference between Mo diffusivity and W diffusivity at the same conditions. However, Cu diffusivity is higher by several orders of magnitude. Modeling results indicate that during the formation of porphyry deposits, the transfer of Cu from melt to fluid bubbles or sulfide is highly efficient. In contrast, due to their low diffusivities, the degree of enrichment for Mo and W in fluid is appreciably lower than equilibrium partitioning would allow. Slow diffusion of Mo and W may be the rate-limiting step in the formation of porphyry Mo/W deposits.