

***In situ* constraints on Zn behavior in magmatic-hydrothermal fluids.**

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Zn is nowadays one of the most important metal commodities in view of energy transition, being used in varied industrial applications as a galvanizer in building and transport construction. Its elemental ratios (e.g., Zn/Fe) and isotopes are also used as tracers of magmatic or planetary processes. It is commonly found on Earth in magmatic-hydrothermal ore deposits (porphyry-epithermal, skarns, pluton-related veins or massive sulfides). A better understanding of Zn uptake, concentration and deposition mechanism, from a potential magmatic source to host rocks requires accurate knowledge of its fluid-melt partitioning, speciation and solubility in high-T fluids. Up to now, studies on Zn speciation in acidic fluids have revealed that Zn is transported in mixed oxy/hydroxyl/chloride to low temperatures (<200°C) while chloride complexes prevail in higher ones (>200°C) [1,2]. However, these experiments were performed *ex situ*, lacking direct information at HP-HT. Zn fluid-melt partitioning studies are rarer and limited to a few compositions and P-T conditions which need further investigation [3]. They indicate that Zn could have an affinity for the fluid at HT (*D* values ranging from 5 to 27). Here, we will present a new set of *in situ* experiments on Zn speciation, fluid-melt partitioning and sphalerite (ZnS) solubility in magmatic-hydrothermal fluids considering the P-T conditions of arc systems (600-1000 bar and up to 800°C) while acknowledging the compositional diversity of magmas and fluids. Those experiments involved the use of a HP-HT transparent internally heated pressure vessel in combination with synchrotron X-ray absorption (XANES and EXAFS) and Raman spectroscopies. Preliminary results indicate an important influence of temperature, salinity and a minor effect of pH on Zn speciation and Zn seem to be more partitioned in the fluid when Cl is present. We also report on the solubility of sphalerite in Cl-bearing fluids, with direct observation of dissolution/precipitation of secondary ZnS layers controlling the solubility at 400-450°C. The implications of these observations for Zn mobility in fluids at a larger scale will be discussed.

[1] Mei *et al.*, 2015. *GCA* 150, 265.

[2] Etschmann *et al.*, 2019. *Am. Mineral.*, 104, 158

[3] Gion *et al.*, 2022. *Chem. Geol.* 609, 121061.