

***In situ* experimental studies of As enrichment and transport in magmatic-hydrothermal fluids**

DARIA DIAGILEVA¹, MARION LOUVEL², TOM CHATELIN², CORDULA PAULINE HAUPT, PHD², JEAN-LOUIS HAZEMANN³ AND CARMEN SANCHEZ-VALLE⁴

¹Universität Münster, Institut für Mineralogie

²ISTO, UMR 7327, Univ Orléans, CNRS, BRGM, OSUC

³Institut Néel - CNRS - Univ Grenoble Alpes - FAME beamline
- European Synchrotron Radiation Facility

⁴University of Münster

Arsenic is ubiquitous in all kinds of gold deposits and an indicator for Au, Ag, Cu and Zn deposits in the crust. In recent years, the interest in arsenic has resumed due to its use in semiconductor nanowire technologies with potential applications to topological quantum computation devices [1]. Understanding the enrichment of As and its association with critical metals requires better constraints of its extraction from magma sources during degassing and transport mechanism to shallower settings, as well as on the dissolution-precipitation of As-bearing minerals at relevant conditions.

The majority of solubility and speciation studies of As focused on the hydrothermal process in the shallow crust [2], while fluid/melt partitioning data has been obtained from natural and synthetic fluid inclusions [3, 4], which do not enable direct characterization of element speciation at relevant conditions (700 – 850 °C, 1 – 3 kbar).

Here we apply *in situ* synchrotron-based XAS and XRF techniques coupled with the FAME hydrothermal autoclave to determine arsenic fluid/melt partition coefficients and speciation at magmatic-hydrothermal conditions, and the solubility of realgar (As₄S₄) in saline hydrothermal fluids. The experiments were conducted at BM16 (FAME-UHD) beamline of the ESRF. Our results constrain the effects of temperature, pressure, and ligands (S and Cl) on the distribution and speciation of arsenic during magma degassing at 1 kbar and 760 °C, which provide estimates of the arsenic budget of magmatic volatiles. Moreover, a comparison of our results on realgar with previous *ex situ* studies of orpiment [5] and arsenopyrite [6] solubilities provides new insights into the role of sulphur and chlorine in the transportation of arsenic in hydrothermal fluids.

[1] Aghaee. *et al.* (2025), *Nature* 638, 651-655.

[2] Pokrovski *et al.* (2002), *Geochim. Cosmochim. Acta* 66, 3453-3480.

[3] Simon *et al.* (2007), *Geochim. Cosmochim. Acta* 71, 1764-1782.

[4] Zajacz *et al.* (2008), *Geochim. Cosmochim. Acta* 72, 2169-2197.

[5] Pokrovski *et al.* (1996), *Geochim. Cosmochim. Acta* 60, 737-749.

[6] Pokrovski *et al.* (2002), *Geochim. Cosmochim. Acta* 66, 2361-2378.