Mineralizations monitor depth and composition variations of paleohydrothermal fluid systems

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More than 1000 hydrothermal mineralizations in the Schwarzwald ore district of SW Germany formed discontinuously over the last 300 Ma [1]. Fluid inclusions, structural and mineralogical specifics allow to distinguish six different mineralizing fluid systems [2]. Most mineralizations formed by mixing of a deep-seated and a near-surface fluid. Interestingly, ore mineral compositions (especially fahlore [3]) and fluid inclusion systematics appear to reflect the relative importance of the deep and the shallow fluid systems, while e.g. Sr or Pb isotope systematics allow to quantify their contributions more precisely in some cases. Stable sulfur, oxygen and carbon isotope systematics allow to draw conclusions regarding the source of these (and geochemically similar) elements.

Combination of these various methods allows to characterize paleofluid systems with respect to their composition, their timing and their ore-forming potential in great detail on a district-wide scale and thereby help to understand the communication of deep and shallow aquifers over time in a typical crustal block of 100x50 km size.

[1] Pfaff *et al.* (2009) *Eur. J. Min.* **21**, 817. [2] Staude *et al.* (2009) *EPSL* **286**, 387. [2] Staude *et al.* (2010) *Min. Mag.* **74**, 309.

Volatile elements in apatite: An integrated analytical approach with special focus on bromine

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We analyzed a Durango apatite crystal and apatites from five plutonic samples from the alkaline Mt. Saint Hilaire Complex (Canada) by means of Electron Microprobe Analysis (EPMA), Laser Ablation ICP-MS (LA-ICP-MS), Secondary Ion Mass Spectrometry (SIMS), pyrohydrolysis combined with ion chromatography, Fourier Transformed Infrared Spectroscopy (FTIR), Instrumental Neutron Activation Analysis (INAA) and Total Reflection X-ray Fluorescence Analysis (TXRF).

The focus of our study are volatile elements (F, Cl, Br, S, C) with a special emphasis on Br, since the analytical possibilities for this element are especially in the low- to sub-μg/g range restricted and thus, reliable concentration data for Br in rock-forming minerals are scarce. We demonstrate here that TXRF, which is barely used in geosciences so far, is suitable for analyzing the bulk content of Br and Cl as well as of a range of important minor and trace elements (e.g. Sr, Ce, Fe, Mn, As) in apatite simultaneously. The TXRF method combines the advantages of low to very low detection limits (μg/g- to sub-μg/g range), small sample amounts needed (mg range) and a relatively fast and inexpensive analytical procedure. In the case of apatite, reliable concentration data for Br can be produced with detection limits in the sub-μg/g range. The analysis of Cl is also possible, if a suitable correction method, which accounts for the observed systematic underestimation, is applied. For investigations, where space-resolved data are needed, a large geometry SIMS machine offers the possibility to analyze F, Cl, Br and S if reliable data for suitable reference materials exist.

Based on our data, we propose an average Br concentration of around 0.1 μg/g as a preliminary reference value for the Durango apatite. However, more data on the Br content of the Durango apatite are needed in order to validate this value.