The effect of sulfur on the vapor-liquid distribution coefficient of Cu and Zn in boiling hydrothermal fluid

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In the formation of porphyry-Cu deposits, the boiling of hydrothermal fluid has been considered to be an important process for the selective extraction of copper. For example, the analyses of fluid inclusions trapped boiling hydrothermal solutions (e.g., Heinrich et al., 1992) suggests that fluid inclusions trapping magmatic vapor contain more copper than other heavy metals, while liquid-rich inclusions contain more iron, zinc and lead than copper. To know the copper enrichment in vapor inclusions in detail, especially the role of sulfur, vapor-liquid partitioning coefficients of Cu and Zn for sulfur-bearing and sulfur-free aqueous fluid are experimentally obtained at 500-650 C and 35-100 MPa, which are the boiling conditions of the NaCl-H2O solutions.

Synthetic fluid inclusion technique was employed as an experimental method. Fluid inclusions whose starting materials were 1500-12000 ppm Cu and Zn with 10- 30 wt% NaCl aqueous solutions and 0-1.8 mol/kgH2O elemental sulfur were synthesized in quartz cores. After the experiment, the coexistence of vapor-rich and liquid-rich inclusions was observed in the specimens, and they were analyzed individually by synchrotron radiation x-ray fluorescence (Nagaseki and Hayashi, 2005).

It shows that Cu-rich and Zn-poor vapor inclusions and Cu-poor and Zn-rich liquid inclusions, which are similar to the naturally occurred fluid inclusions, were successfully synthesized. KD [= (concentrations in vapor) / (concentrations in liquid)], the vapor-liquid distribution coefficient of solutes suggests that the chemical species of copper at sulfur-rich conditions may be different from that in sulfur-free conditions. The logKD value for Cu gradually increases with sulfur content and becomes KD=25 for sulfur-rich conditions. On the other hand, logKD for Zn is independent on sulfur content. It demonstrates that the hypothesis proposed by Heinrich et al. (1992) that sulfur is responsible for copper enrichment in vapor.

References:
Heinrich, C.A., Ryan, C.G., Mernagh, T.P., Eadington, P.J., (1992) Econ. Geol. 87, 1566-1583.
Nagaseki, H., Hayashi K., (2005) Abstracts, 2005 Japan Earth and Planetary Science Joint Meeting, J030P-003.