Enhanced Fe solubility in vapor-rich hydrothermal fluids: Implication for Fe mobility in seafloor vent systems

YANLU XING[1*], PETER SCHEUERMANN[1,2], WILLIAM E. SEYFRIED JR.[1]

[1]Department of Earth and Environmental Sciences, University of Minnesota, Minneapolis, MN 55455, USA (*correspondence: xing0048@umn.edu; wes@umn.edu)

[2]Department of Earth, Ocean and Atmospheric Sciences, University of British Columbia, Vancouver, BC V6T 1Z4, Canada (pscheuer@eoas.ubc.ca)

In seafloor hydrothermal systems, vent fluids usually contain elevated dissolved iron (Fe)(0.5-13mmol/kg) that are significantly enriched relative to deep ocean sea water (~1nmol/kg; [1]). It is commonly thought that significant Fe transport is only possible in dense Cl-rich fluids due to the formation of aqueous Fe-Cl complexes [2]. However, the Fe enrichment in vent fluids with low Cl concentrations(<550 mmol/kg) indicates that the vapor phase may be important for Fe transport in seafloor hydrothermal systems [1]. Vapor transport of Fe is weakly understood due to the lack of high T-P solubility experiments and thermodynamic data. Here, we report vapor Fe solubility data in KCl-H_2O system via experiment conducted at 400-500 ºC, 200-510 bar. The experiment was performed by using hematite-magnetite assemblage as the source of Fe, and K-feldspar-muscovite-quartz assemblage as the pH buffer. Significant amounts of Fe in vapor were recognized, with the highest Fe concentrations (up to 2040 μmol/kg) achieved at 425-450 ºC and pressure ranging from 335 to 415 bar. Our results show that Fe concentration increases with increasing pressure, Cl concentration and density. In particular, a good exponential correlation between Fe concentration and pressure was recognized, making Fe value in vent fluids potentially a good geothermobarometer for understanding hydrothermal processes that happen in depth of oceanic floor. The new data indicates that increased Fe flux found in Mid-Ocean Ridge duing glacial terminations may be a result of release of condensed vapor phase from deep oceanic crust.

[1] German and Seyfried. (2014) *Hydrothermal Processes, Treatise on Geochemistry*, 191-233.
[2] Pokrovski, Roux and Harrichoury. (2005) *Geology*, **33(8)**, 191-233.