

Experimental measurement of $H_{2(aq)}$ solubility in hydrothermal fluids: application to the Piccard hydrothermal field, Mid-Cayman Rise

PETER P. SCHEUERMANN*, YANLU XING, KANG DING,
WILLIAM E. SEYFRIED JR.

University of Minnesota, Department of Earth and
Environmental Sciences, Minneapolis, MN 55455 USA

*scheu101@umn.edu

In mid-ocean ridge hydrothermal systems the fluid redox state is controlled by oxidation of ferrous iron in the host rock and generation of aqueous hydrogen, $H_{2(aq)}$. A quantitative interpretation of redox state requires conversion of $H_{2(aq)}$ concentrations to H_2 fugacity ($f H_2$). Here we present the results of hydrothermal experiments that calibrate the $f H_2$ -concentration relationship in saline hydrothermal fluids, Y_{H_2-Cl} . $H_{2(aq)}$ concentrations were measured between 400-500 °C, 21-51 MPa, in both single phase fluids and coexisting vapor-liquid in the KCl- H_2O system, as buffered by hematite-magnetite. Values of Y_{H_2-Cl} are well above unity and decrease as temperature increases. In combination with previous determination of $H_{2S(aq)}$ solubility at hydrothermal conditions, the data presented here permit calculation of the redox conditions of natural vent systems. Redox conditions calculated for the basalt-hosted Piccard hydrothermal field suggest amphibolite facies mineral assemblages are present at depth, consistent with the extremely hot temperatures (> 500 °C) inferred from analysis of other aspects of vent fluid chemistry (e.g., Cl and SiO_2). Piccard is the first location of active venting that records evidence for an alteration assemblage that had been previously observed only in fossilized submarine hydrothermal systems.