# Subsurface pressure-temperature conditions and $H_{2(aq)}$, $H_2S_{(aq)}$ generation at the Piccard Hydrothermal field, Mid-Cayman Rise

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The Piccard hydrothermal field is the world's deepest (4,960 m) black smoker vent site. The end member hydrothermal fluids have $SiO_{2(aq)}$ concentrations (20 mM) indicative of extremely high reaction temperatures, as well as a $H_2/H_2S$ ratio greater than other mafic-hosted axial vent systems [1]. Hydrothermal experiments were performed at elevated temperature (420-500ºC) and pressure (32.0-51.0 MPa) in the NaCl-$H_2O$ system to measure quartz solubility in coexisting vapor and liquid and extend the range of the Si-Cl geothermobarometer. When applied to Piccard, the Si-Cl geothermobarometer indicates the hottest and deepest conditions (530-540ºC, 61.5-62.5 MPa) yet recorded by a seafloor vent fluid. At such high temperatures, igneous aluminosilicates that form Fe-Mg solid solutions require relatively small amounts of Fe-enrichment in order to be stable in the presence of $SiO_{2(aq)}$ [2] and could therefore help buffer $H_{2(aq)}$. Taking into account Si-Cl constraints, geochemical modeling suggests that magnetite-pyrrhotite ± olivine ± orthopyroxene equilibria are capable of producing $H_2/H_2S$ ratios consistent with those observed at Piccard. These reactions represent new mechanisms to account for the significantly elevated $H_{2(aq)}$ and $H_2S_{(aq)}$ concentrations measured at Piccard and have direct implications for seafloor microbial communities [3].

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