

Speciation of Fe^{II} in hydrothermal saline brines by x-ray absorption techniques.

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Ferrous iron is the most mobile Fe species in near-surface environments, and is the most stable aqueous form of iron in crustal fluids. Chloride Cl⁻ is the predominant ligand in hydrothermal ore fluids involved in the formation of most metal deposits. It is also important in many hydrometallurgical processes or for corrosion in power- and thermal plants. Aqueous Fe^{II} chloride complexes modify strongly the solubility of Fe-bearing minerals; hence, these complexes play a crucial role in metal transport and deposition in both natural and engineered environments. Despite this, the nature and thermodynamic properties of the aqueous Fe^{II} chloride complexes in hypersaline brines at elevated temperatures and pressures are poorly understood. Some spectroscopic data exist (UV-Vis, x-ray absorption) but are limited either to low chloride concentrations or to low temperatures (<200°C); furthermore, these experiments are often conducted at the vapour saturated pressure conditions.

In the present study, we use synchrotron x-ray absorption measurements to determine the speciation of ferrous iron in hydrothermal saline brines (30-500°C, 300-1000 bar). EXAFS and XANES measurements indicate that increasing chloride concentration and/or temperature favour the apparition of several chloride complexes whose structures are determined.

From these x-ray data the thermodynamic properties of these complexes were also derived. These values are of critical importance for the thermodynamic models used to calculate Fe-bearing minerals solubilities.