## Hydroxyl Radical Formation and Trichloroethylene Degradation in Pyrite-Chalcopyrite Dispersions

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Trichloroethylene (TCE) is a dense, organic, water-soluble solvent that has been used to degrease engines and as a cleaning agent in laundry facilities. TCE is a known carcinogen and its current use is limited; however, TCE remains one of the most common groundwater pollutants in the industrial world. Hence, there has been considerable interest in developing effective, economical techniques to breakdown TCE in situ. One of the more promising strategies is based on stimulating the Fenton reaction in the subsurface. The homogeneous Fenton reaction is the reaction between hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) and ferrous iron, forming hydroxyl radical (OH\*). OH\* reacts rapidly with organic molecules, including TCE. It has been shown that a similar process takes place when H<sub>2</sub>O<sub>2</sub> is injected in sediments contaning ironbearing minerals, where the mineral surface drives the formation of hydroxyl radical. A new promising development is that the mineral pyrite (Py) degrades TCE in aerated solutions. The reaction proceeds via the formation of  $H_2O_2$  and OH\* as part of the step-wise reduction of dissolved molecular oxygen.

Here we report on a study that explores the effect of combining chalcopyrite (Cpy) and Py on the rate of TCE degradation. The addition of Cpy to a Py slurry leads to an enhanced production of hydroxyl radical. The effect is nonlinear and results in a significantly higher TCE degradation rate. We have determined the optimal Cpy/Py ratio. The exact mechanism of the non-linear rate increase in TCE is subject of an ongoing study, but results of a study with adenine as a probe molecular suggest that Galvanic coupling of the two sulfides contributes to the non-linear response as well as what we refer to as a co-factor mechanism. The co-factor mechanism refers to the fact that Cpy rapidly forms hydrogen peroxide when dispersed in water, but the rate of its conversion to hydroxyl radical is slow in Cpy slurries compared to Py slurries. Hence, in combined Cpy-Py slurries, Cpy produces H<sub>2</sub>O<sub>2</sub> that is converted by Py into hydroxyl radical. The results of this study suggest that a better understanding of the interaction among mineral pairs can lead to the development of new in-situ, Fenton-like remediation strategies that do not rely on the injection of H<sub>2</sub>O<sub>2</sub>. (Intellectual Property SBU Disclosure R-8542).