

**Supplementary material**

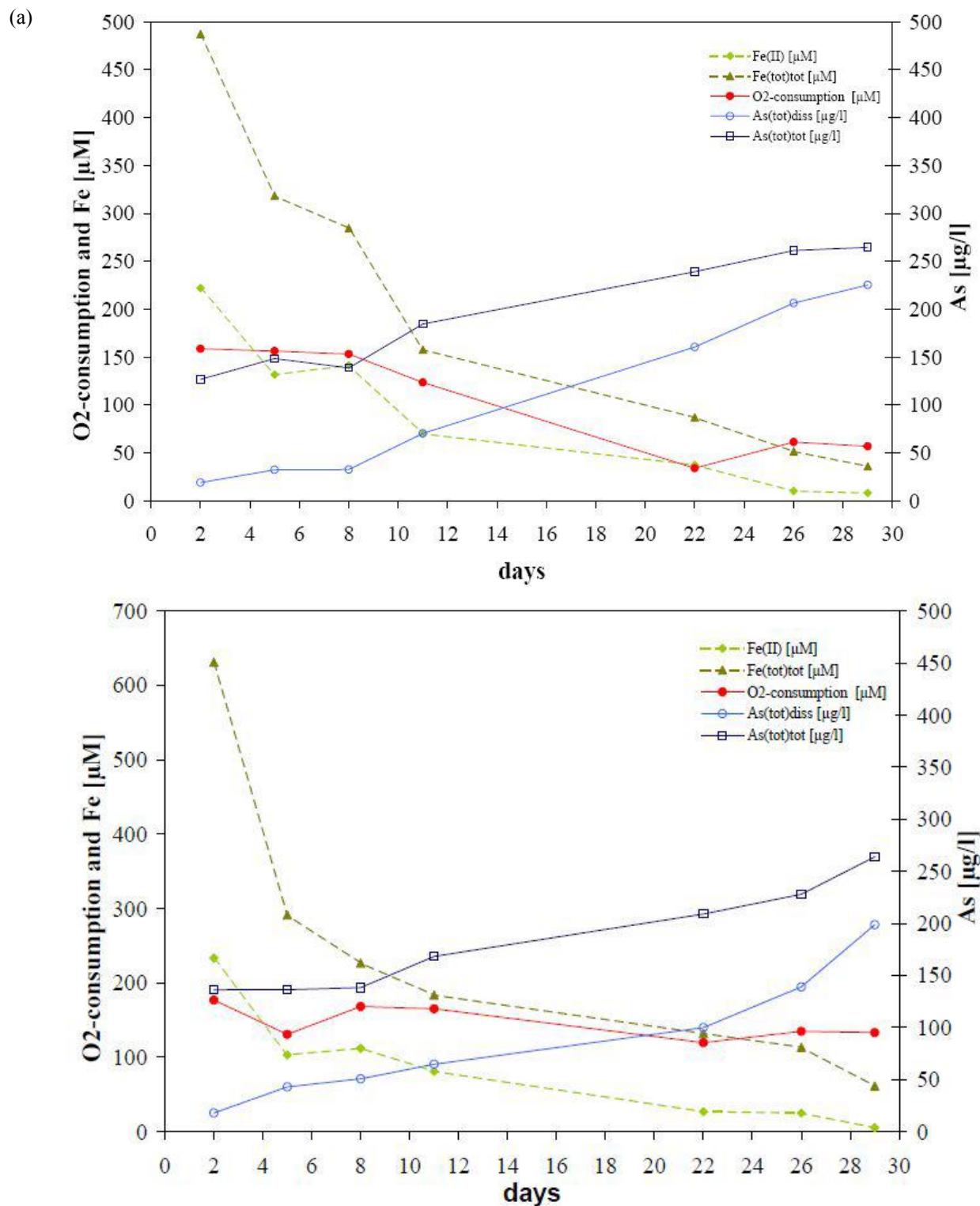
**Factors affecting arsenic and uranium removal with zero-valent iron: laboratory tests with Kanchan-type iron nail filter columns with different groundwaters**

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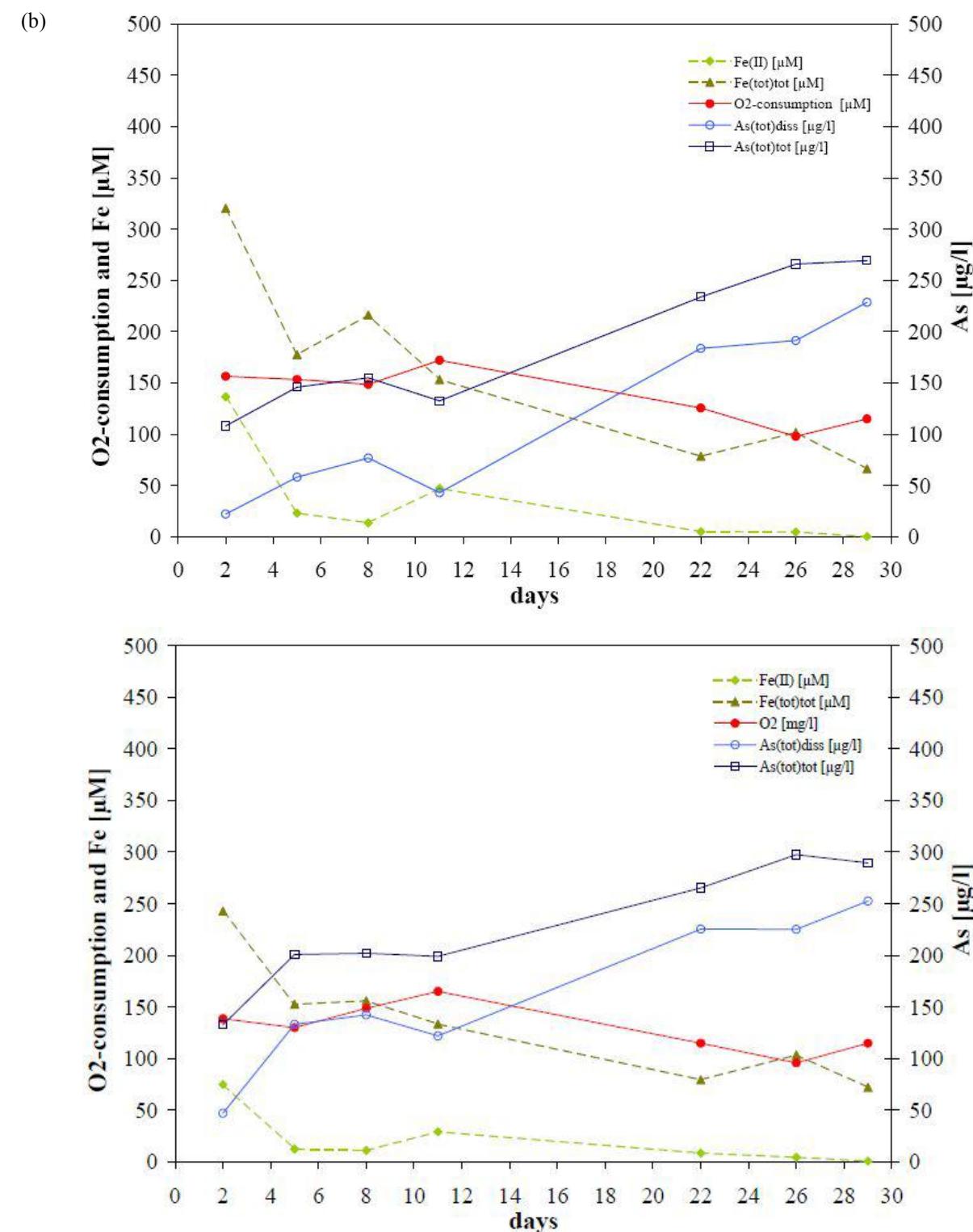
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**Fig. S1.** Concentrations of  $\text{Fe}^{\text{II}}$ ,  $\text{Fe}(\text{tot})\text{tot}$  (dissolved and particle bound  $\text{Fe}^{\text{II}}$  and  $\text{Fe}^{\text{III}}$ ),  $\text{As}(\text{tot})\text{diss}$  (0.2- $\mu\text{m}$  filtered  $\text{As}^{\text{III}}$  and  $\text{As}^{\text{V}}$ ),  $\text{As}(\text{tot})\text{tot}$  (dissolved and particle bound  $\text{As}^{\text{III}}$  and  $\text{As}^{\text{V}}$ ), and (a) oxygen consumption in the effluents and the oxygen consumptions in the columns: (a) column 1 (top) with no P, high Ca, pH 7, and column 2 (bottom) with high P, high Ca, pH 7.0; (b) column 3 (top) with no P, low Ca, pH 7.0, and column 4 (bottom) with high P, low Ca, pH 7.0; and (c) column 5 (top) with no P, low Ca, pH 8.4 and column 6 (bottom) with high P, low Ca, pH 8.4.



**Fig. S1.** (Cont.)

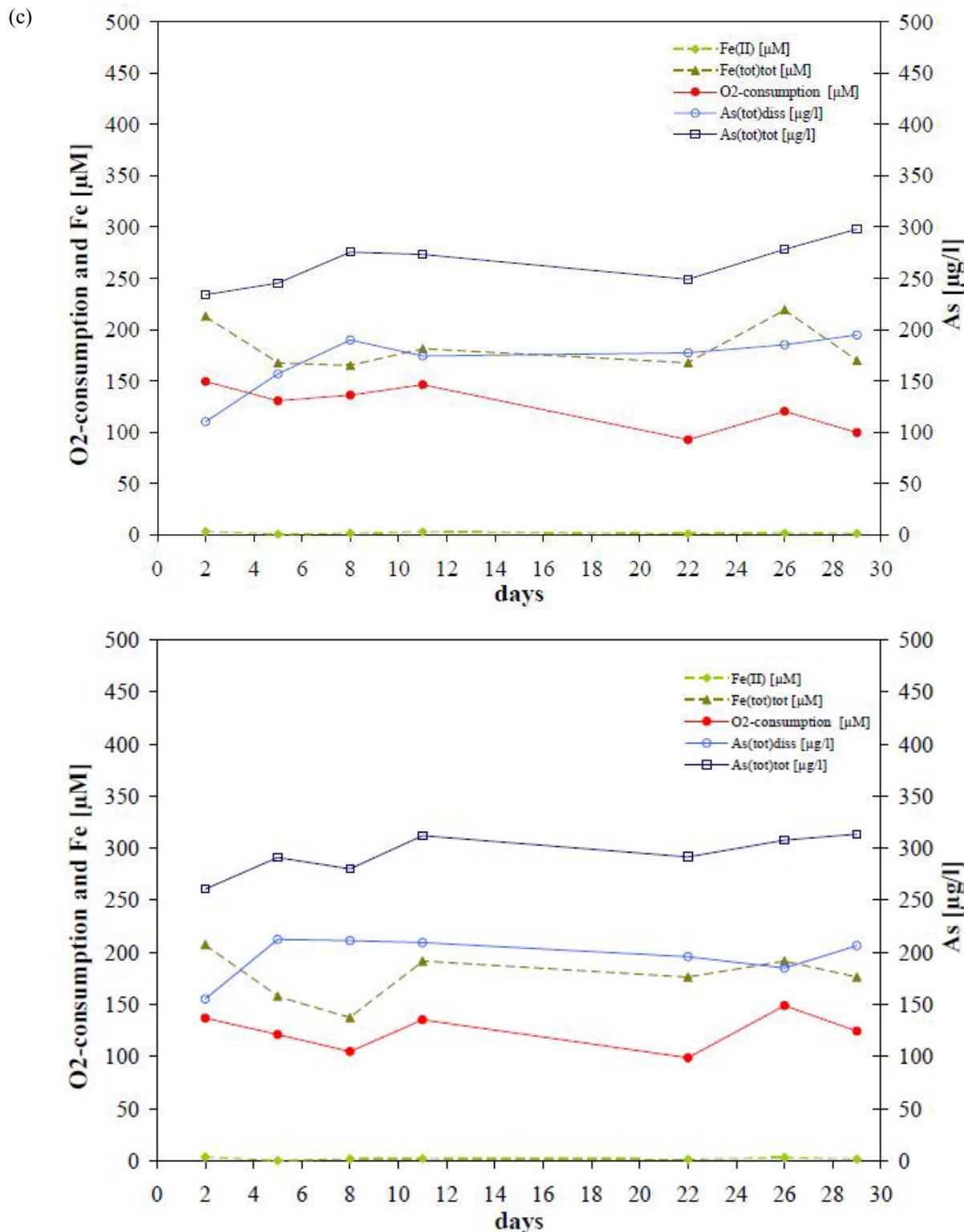
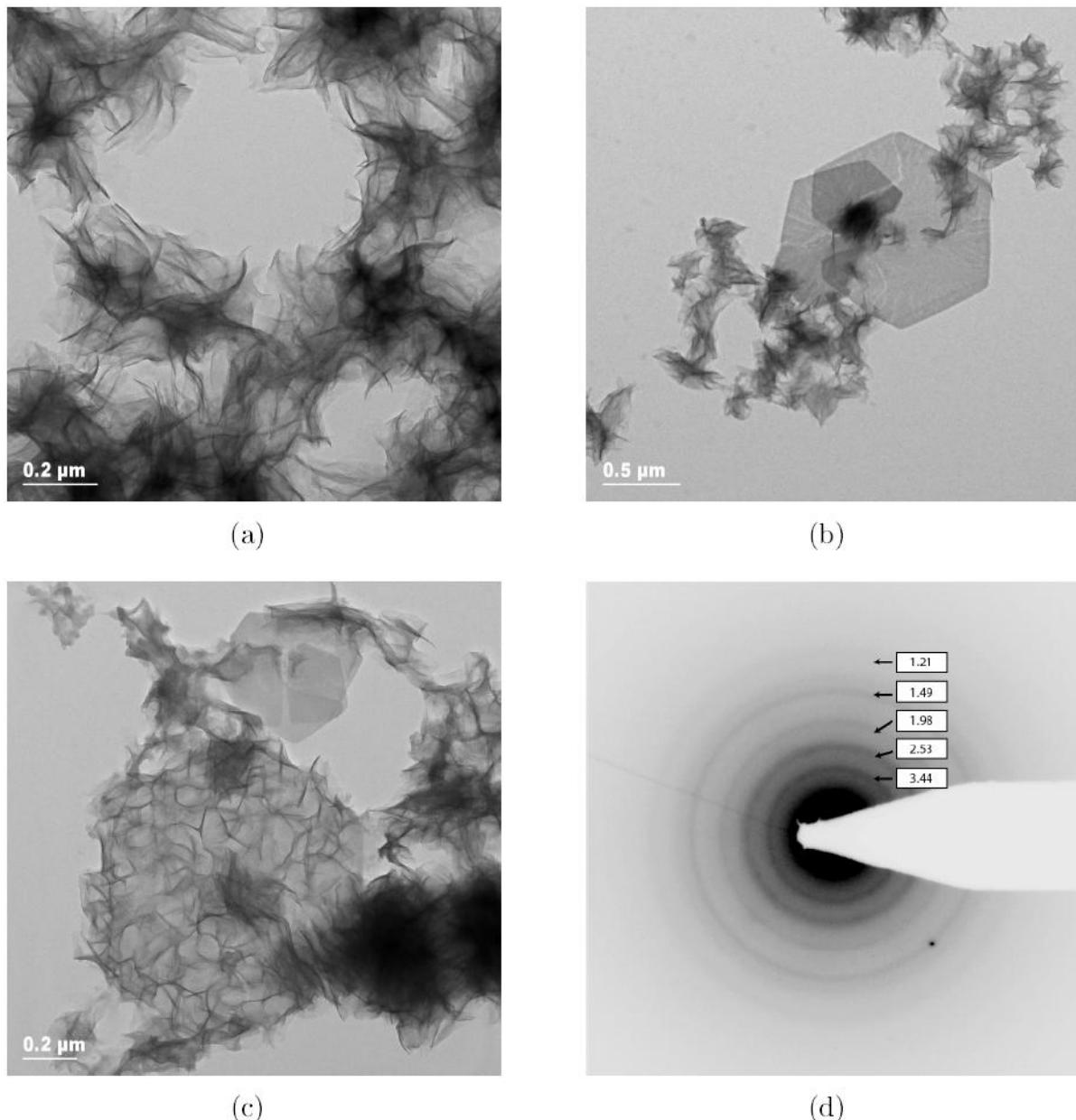
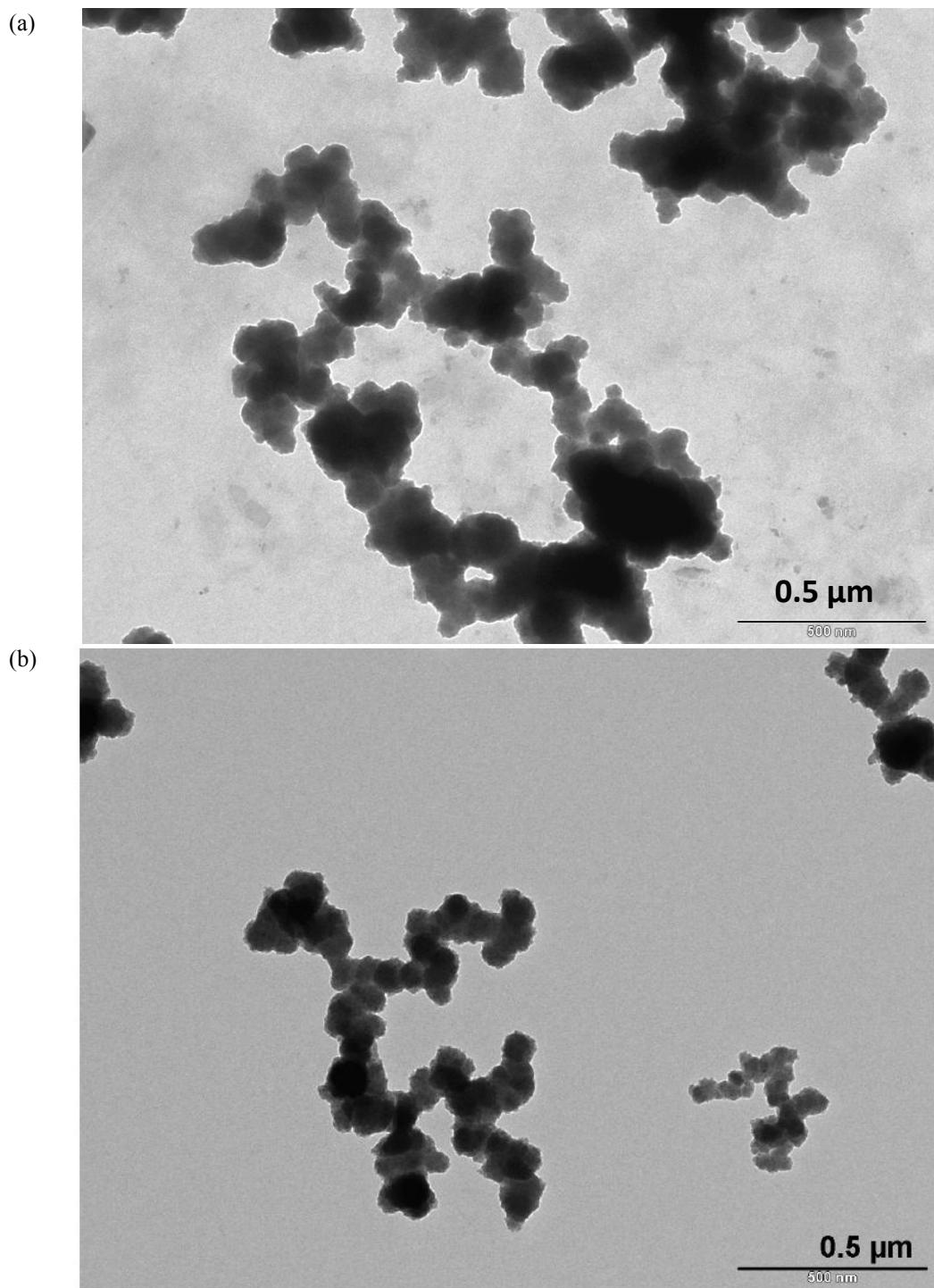


Fig. S1. (Cont.)



**Fig. S2.** TEM bright field images of colloids obtained by exposing 8 nails for 3 hours in 50 mL of groundwater without Si and P at pH 7.0. TEM images in (a) to (c) and Selected Area Electron Diffraction (SAED) in (d). Numbers are lattice spacing in angstrom units. SAED identified the phase in (a) as lepidocrocite. The hexagon-shaped iron phases are likely goethite formed out of lepidocrocite.



**Fig. S3.** TEM bright field images of colloids in the effluents of column 1 (a) and column 2 (b) after 3 days. With high Ca and low P-concentrations in the Si-containing water (top), the colloids consisted of structures that are consistent with ferrihydrite and Si-rich hydrous ferric oxide phases.<sup>[2,3]</sup> The precipitates from the column 2 with high P consist of agglomerates of dense spheres of amorphous Fe<sup>III</sup>-phosphate phases.<sup>[1,2]</sup>



**Fig. S4.** Rusting iron nails with mostly brown Fe<sup>III</sup>-phases and black mixed Fe<sup>II</sup>-Fe<sup>III</sup> phases or magnetite.

## References

- [1] W. Stumm, G. F. Lee, Oxygenation of ferrous iron. *Ind. Eng. Chem.* **1961**, *53*, 143. [doi:10.1021/ie50614a030](https://doi.org/10.1021/ie50614a030)
- [2] A. Voegelin, R. Kaegi, J. Frommer, D. Vantelon, S. J. Hug, Effect of phosphate, silicate, and Ca on Fe<sup>III</sup>-precipitates formed in aerated Fe<sup>II</sup>- and As<sup>III</sup>-containing water studied by X-ray absorption spectroscopy. *Geochim. Cosmochim. Acta* **2010**, *74*, 164. [doi:10.1016/j.gca.2009.09.020](https://doi.org/10.1016/j.gca.2009.09.020)
- [3] R. Kaegi, A. Voegelin, D. Folini, S. J. Hug, Effect of phosphate, silicate, and Ca on the morphology, structure and elemental composition of Fe<sup>III</sup>-precipitates formed in aerated Fe<sup>II</sup> and As<sup>III</sup> containing water. *Geochim. Cosmochim. Acta* **2010**, *74*, 5798. [doi:10.1016/j.gca.2010.07.017](https://doi.org/10.1016/j.gca.2010.07.017)