

Anion-exchange of akaganeite with Mars-relevant anions

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Akaganeite is an iron(III) oxyhydroxide (β -FeOOH) with a tunnel structure usually occupied by Cl⁻ [1]. Chloride in tunnels is mobile and can be replaced by other anions in solution by anion exchange [1]. Akaganeite has been discovered on the surface of Mars [2, 3], however, environmental conditions of akaganeite formation remain unknown. Identification of akaganeite tunnel compositions may help characterize ancient aqueous environments where the mineral is present on Mars.

We have investigated anion-exchange reactions of akaganeite with Mars-relevant anions (Br⁻, OH⁻, F⁻, SO₄²⁻). The reacted akaganeite was characterized by instruments similar to instruments on Mars robotic spacecraft. Chloride-containing akaganeite was incubated in aqueous solution with or without anion addition for 96 hours at 55°C. Anion-exchange experiments revealed that the total Cl⁻ release from akaganeite followed the order: solution with no added anions (20% Cl⁻ released) < Br⁻ \approx SO₄²⁻ (50%) < F⁻ (60%) < OH⁻ (85%). X-ray diffraction analysis showed that peaks in the reacted samples were shifted relative to the starting material indicating that peak positions were sensitive to the channel anions. The reacted akaganeite samples were also characterized by infrared spectroscopy, and volatiles were analysed by thermal and evolved gas analysis. The characterization data indicate that akaganeite of different tunnel composition can be distinguished with instruments on robotic Mars missions. The results will be compared to published data from rover and orbital missions [2-4] to characterize martian akaganeite tunnel composition and formation conditions.

[1] Cai et al. (2001) *Chem. Mater.*, 4595-4602. [2] Vaniman et al. (2014) *Science*, vol. 343; [3] Carter et al. (2015) *Icarus* 296-310; [4] Ming et al. (2014) *Science*, vol. 343.