Nickel behavior toward biogenic mackinawite during laboratory experiments aimed at mimicting mangrove sediments

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The growing need for nickel (Ni) in industry implies increasing mining and subsequent release in surrounding environments. In tropical areas, Ni mining mainly concerns lateritic ores that are often connected with coastal ecosystems such as mangroves. In the anoxic sediments of these mangroves, Fe-(hydr)oxides are dissolved by iron-reducing bacteria (IRB) while sulfates/thiosulfates are reduced by sulfate/thiosulfate-reducing bacteria (SRB), leading to aqueous Fe(II) and H_2S that further react to precipitate Fe-sulfides (Canfield et al., 1992; Rickard & Luther, 2007; Otero et al., 2009). Since these Fe-sulfides can have a strong affinity for a large set of trace metals (Jong & Parry, 2004; Kwon et al., 2015), evaluating their actual role in the biogeochgemistry of Ni in mangrove sediments that receive increasing inputs from mining activitiy is an important issue.

In the present study, we investigated the behavior of Ni upon Fe-sulfides formation during laboratory experiments performed with *Desulfovibrio capillatus*, a thiosulfate-reducing strain, in the presence of soluble Fe(III)-citrate and thiosulfates. XRD and Fe K-edge EXAFS results indicate that biogenic mackinawite (FeS_{1-x}) is the end-product mineral and Ni K-edge EXAFS results show that Ni is structurally incorporated in this biogenic mackinawite through substitution with Fe. In addition, comparison between Ni and Ni-free experiments indicates that the growth kinetic of mackinawite particles is significantly accelerated when Ni occurs in the starting solution. Regarding the large amounts of Ni incorporated in mackinawite (i.e. up to 98% of initial Ni), these results emphasize the strong sequestering capacity of this biogenic Fe-sulfide toward Ni in mangrove sediments. Finally, they also indicate that this sequestering capacity can be driven by thiosulfate-reducing bacteria activity.

Canfield et al. (1992) *Am. J. Sci.*, 292, 659-683; Otero et al. (2009) *Geoderma*, 148, 318-335; Rickard & Luther (2007) *Chem. Rev.*, 107, 514-562; Jong & Parry (2004) *JCIS*, 275, 61-71; Kwon et al. (2015) *Am. Min.*, 100, 1509-1517.