Biogenic green rust: a backbone of the iron biogeochemical cycle

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Green rusts (GRs) are a Fe^{II}-Fe^{III} hydroxysalts minerals well known as an iron corrosion product on cast-iron water pipes, before being discovered in a natural environment in hydromorphic soils as fougerite, and in ferruginous lakes [1]. GRs play a major role in toxic metals (e.g.: Hg^{II}), organic (e.g.: chlorinated solvents) and inorganic (e.g.: NO_3^-) pollutant remediation due to the presence of Fe^{II} promoting their reducing capability. While the mechanisms on the formation of chemically synthesized GRs have already been investigated [2], little has been achieved on their formation and their reactivity in the environment where bacteria are naturally found everywhere. Therefore, GRs are attracting a growing interest among the scientific community, in particular as a transient mineral formed by iron-reducing bacteria (IRB) [3], iron-oxidizing bacteria (IOB) and nitrate-reducing bacteria (NRB) *via* a production of biogenic nitrite [4] (Fig. 1).

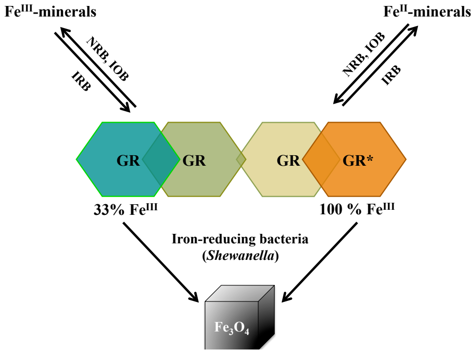

Figure 1. GRs in the Fe biogeochemical cycle.

However, GRs are metastable and turn into magnetite, a more stable Fe^{II}-Fe^{III} mineral. But in recent findings we demonstrate the stabilization of GRs in the presence of biological materials (such as biopolymers) by various techniques highlighting microbe/mineral interactions (XRD, TEM, SEM, Raman, AFM, Mössbauer), thus explaining their occurrence and reactivity in environmental conditions.

[1] Zegeye *et al* (2012) Geology **40**, 599-602 [2] Ruby *et al* (2006) C.R. Geosci. **338**, 420-432 [3] Jorand *et al* (2013) *Geomicrobiol. J.* **30**, 600-615 [4] Etique *et al* (in revision) *Environ. Sci. Technol.*