Transformation of siderite/magnetite corrosion bilayers to mackinawite and greigite by nitrate-reducing bacteria (*Klebsiella mobilis*)

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A major problem facing the nuclear industry has to do with radioactive waste. In the anoxic conditions of nuclear waste repository, the main iron corrosion products formed at the surface of the non-alloy steel are siderite ($FeCO_3$) and magnetite (Fe_3O_4) that form a rather protective layer on the metallic envelopes [1].

The originality of this work is the consideration of the bacterial metabolism of nitrate-reducing bacteria (NRB) often overlooked in corrosion processes, as opposed to those taken into account for several years (e.g. sulphate-reducing bacteria). *Klebsiella mobilis* was used as a model of NRB and incubated with siderite/magnetite corrosion bilayers in the presence of dihydrogen and lactate (as electron donors), and nitrate and sulfate (as electron acceptors). At the issue of the bacterial incubation, magnetite was reduced to mackinawite (FeS) and transformed to greigite (Fe_3S_4).

A new mechanism is suggested based on the combination of biotic and abiotic processes: (i) in growth phase, NRB reduce sulfate to sulfide via an assimilatory pathway (to supply their needs in sulfur); (ii) during bacterial lysis, a significant amount of sulfide is released and reduces Fe^{III} species of magnetite to Fe^{II} species; then, (iii) mackinawite is formed by the coprecipitation of Fe^{II} species with remaining sulfide; lastly, (iv) mackinawite is sightly oxidized to greigite by nitrite produced by the respiration of nitrate by NRB.

[1] Féron & Crusset (2014) *Corros. Eng. Sci. Techn* **49**, 540-547.