Bacterial FeIII reduction enhances the dissociation of Fe oxyhydroxides - organic matter associations in podzolic Bhs soil horizons

M.-L. VERMEIRE[1], S. BONNEVILLE[2], B.STENUIT[1], B. DELVAUX[1], J.T. CORNELIS[3]

[1] ELI, Université catholique de Louvain, Croix du Sud 2, 1348 Louvain-la-Neuve, Belgium (*correspondence : marie-liesse.vermeire@uclouvain.be)

[2] DSTE, Université libre de Bruxelles, Campus Solbosch CP 160/02, Bruxelles, Belgium

[3] Gembloux Agro-Bio Tech, University of Liège, Passage des Déportés 2, 5030 Gembloux, Belgium

Fe oxyhydroxides in soils can bind large amounts of dissolved organic matter (DOM) because of their specific surface area and variable charge surface. The formation of DOM–Fe oxide association is a major process of soil organic matter (SOM) protection against heterotrophic respiration, as well as a control of Fe oxyhydroxide reactivity and evolution. Fe^{III} oxyhydroxides can undergo reductive dissolution in anoxic conditions without any biotic control. Yet it is now evidenced that microbial Fe^{III} reduction primarily controls iron redox chemistry, and is one of the most significant event in soils. However, little is known on the impact of dissimilatory Fe^{III} reduction on the fate of the Fe-SOM association in soils. We incubated during 96h three soil samples from Bhs horizons in the presence of *Shewanella putrefaciens,* a well-known dissimilatory Fe^{III}-reducing bacteria. We measured the kinetics and extent of the release of DOM, Fe2+ and total Fe in solution. The three selected Bhs horizons are 270, 330 and 550 yr-old and were collected in a podzolic chronosequence. The soil free Fe content amounts to 2.648, 21.632 and 26.114 g kg^{-1} of soils, respectively in 270 yr-Bhs, 330 yr-Bhs and 550 yr-Bhs. The contents of both the short-range-order (SRO) Fe phases and mineral-protected C also increase with age from 2.271, 11.645 to 24.847 g kg^{-1} (SRO), and 0.8, 13.2, 15.9 g kg^{-1} (C) respectively in 270 yr-Bhs, 330 yr-Bhs and 550 yr-Bhs. We show that the release of dissolved Fe^{2+} and C increases by 2.8-fold and 1.7-fold, respectively, in the presence of *Shewanella putrefaciens* compared to control experiment. Furthermore, the kinetics of C release strongly follows the one of Fe^{2+} release. The concentration of DOM is positively correlated with the Fe^{2+} concentration in the presence of *S. putrefaciens*. Our results, showing the release of both Fe^{2+} and DOM, suggest that the dissimilatory Fe^{III}-reduction during soil anoxic events can have a significant impact on the mobilization of Fe and OM, hence on the podzolization process.