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

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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, Fe^{2+} 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.