Aerobic microbial respiration of Fe (II) reacted ferrihydrite-natural organic matter coprecipitates

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Iron (Fe) oxide minerals and organic matter can form coprecipitates that retains carbon (C) in soil and sediments. When Fe oxide minerals come in contact with reduced iron (Fe(II)) they can undergo atom exchange reactions, which can cause them to transform and ultimately affect the coprecipitated C. We propose that the length of time Fe(II) is reacted with the Fe oxides will impact the degree of transformation and subsequent changes in C availability. In this study, we synthesized coprecipitates of ^{13}C labelled natural organic matter (NOM) and ferrihydrite (Fh) with C/Fe molar ratios of 1.8 and 0.8, reacted them with Fe(II) for 1d and 14d and then examined C availability. The reacted coprecipitates and unreacted controls were incubated under oxic conditions for 45d with a soil microbial inoculum. Biodegradation of C was tracked by measuring the headspace $CO_{2\,(g)}$ and $\delta^{13}CO_{2\,(g)}$ and the total C content before and after incubation study along with released DOC. Fe phases were characterized using Mössbauer spectroscopy. Results suggest that Fe(II) reacted samples retained more C than the controls and this effect was more prominent with a C/Fe ratio of 0.8 than 1.8. Samples reacted for 1d retained more C than the samples reacted for 14d, which could be due to the lower crystallinity having more surface area to sorb C than the 14d samples. $CO_{2\,(g)}$ emission was higher for the first few days regardless of reaction time. Overall, the presence and reaction time of Fe(II) with Fh-NOM clearly induced changes in the bioavailability of C. Long Fe(II) exposure such as would result following prolonged anoxia is thus likely to shorten C turnover times even if the Fe minerals do not dissolve.