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From solid to liquid: assessing the release of organic matter into soil solution in response to land-use conversion in Brazilian Oxisols

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Recent advances in freshwater research indicate that roughly double the quantity of carbon is exported from soils to streams and rivers than was previously estimated, and that the age of carbon exported from major rivers globally increases with greater human disturbance in the watershed. This implies that human land-use can release old, previously mineral-associated C into solution with subsequent export to groundwater and ultimately freshwater systems where terrestrial organic matter is either mineralized to CO_2, stored in aquatic sediments, or exported to the ocean. Consequently, it is important to understand the mechanisms that cause the release of SOM that is mineral-bound into solution in response to human disturbance and land-use change. Research methods have been established to examine both the fast turnover, dissolved pool of soil organic matter (SOM), as well as the slow turnover, mineral-associated pool. However, to better characterize the response of the total SOM pool to disturbance, it is necessary to understand the interactions between these functional pools by examining them both simultaneously. This study seeks to examine the interaction between dissolved organic matter (DOM) and bulk SOM throughout the soil profile in response to conversion of Brazilian Cerrado (savannah forest) to Eucalyptus plantation forest on the same soil type. The water-extractable organic matter was obtained from soil samples down to 150 cm, characterized using fluorescence and NMR spectroscopy, and carbon-dated. Simultaneously, bulk mineral soil samples were analyzed for microbial biomass, carbon content and age, and characterized using Fourier Transform Infrared Spectroscopy. SOM spectra were obtained by washing subsamples with sodium hypochlorite and subtracting the subsequent mineral matrix spectra from bulk soil spectra. Preliminary results show that microbial biomass decreases much more quickly with depth than DOM, suggesting that C released into solution from deeper horizons may be less likely to be intercepted, and thus preferentially leached to groundwater. Native Cerrado forests had substantially more roots compared to Eucalyptus, and also released substantially larger quantities of DOM from their O horizons. Processes operating at the interface between solid and liquid, terrestrial and aquatic are a key unknown in the global carbon cycle. This research permits a unique snapshot into the relationship between DOM and SOM and the response of these pools to land-use change in Brazil.