

Fate of condensed aromatic carbon in iron-rich soils: Results for simulated Fenton reactions

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Soil organic carbon (SOC) contains a fraction of condensed aromatic carbon (ConAC) commonly referred to as black carbon. The ConAC fraction is comprised of chemically stable structures, which are resistant to bio-degradation, and radiocarbon dating suggests that ConAC can persist for millenia. During wetting events, such as precipitation, oxygen is supplied to the soil profile causing various oxic chemistries to occur. One key process is the conversion of Fe(II) to Fe(III) associated with the production of hydroxyl radicals via Fenton chemistry. These reactive radicals are known to remineralize SOC to CO₂ leading to soil decarbonization. The fate of ConAC in these radical processes is currently unknown. Given the current knowledge from radiocarbon dating, we suspect that ConAC may be resistant to abiotic degradation by hydroxyl radicals, but the opposite may be the case. We test this by incubating soils of low, medium, and high iron content with hydrogen peroxide to trigger the production of OH radicals via Fenton chemistry under laboratory conditions. This simulates environmental wetting and soil aeration in natural systems. Soils were incubated over five days and sub-samples were taken daily for bulk SOC, ConAC, and molecular-level measurements. The ConAC fraction is detected using benzenepolycarboxylic acid markers and the presence of condensed aromatic features in Fourier transform – ion cyclotron resonance – mass spectra. The results from this study provide a mechanistic understanding of the refractory ConAC molecules and their fate in terrestrial soil systems.