BIOCHAR NANO-PARTICLE REACTIVITY AND IMPLICATIONS FOR METAL TRANSPORT

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Biochar is a recalcitrant aromatic carbon-rich product from the pyrolysis of biomass naturally in forest fires or artificially in kilns, under anoxic to limited oxygen conditions for agriculture use, carbon sequestration, or environmental remediation. Biochar is a relatively inexpensive potential alternative material for contaminant removal, water purification, carbon sequestration, and soil amendment (Ahmad et al., 2014; Atkinson et al., 2010; and Liang et al., 2006). Biochar's high surface reactivity and the ease of engineering its surface functional groups to optimize its application to specific conditions has garnered worldwide interest in recent years. Fossil biochar, often referred to as fusian, from ancient natural wildfires have being preserved in the rock record from as early as the late Devonian (Scott, 2000). Availability of abundant naturally occurring biochar may have significant implications on the evolution of ecosystems and possibly planetary-scale metal migration to the oceans via rivers.

While biochar has shown much promise in applications such as soil amendment, water treatment, and carbon sequestration; the impacts of biochar nanoparticles (BCNP) generated during pyrolysis and upon chemical and microbiological degradation under natural environmental conditions are unknown. Compared to bulk biochar, BCNPs have a larger surface area to mass ratio; hence are relatively more reactive and have a higher metal loading capacity. Due to their colloidal size, BCNPs are also far more mobile in porous media (Wang et al., 2020). Understanding the generation, mobility, and reactivity of these BCNPs is essential to understanding the potential migration of toxic metals from large-scale application such as agriculture and carbon sequestration and possibly metal migration through geologic history. This project characterized BCNP surface reactivity, from three biomasses which represent North American landscape, using titration, FTIR, SEM, and Zeta potential data. BCNP surface functional group types, pKa, site concentrations, surface morphology, and inter-particle interaction will be modeled across relevant natural pH ranges in the environment providing a robust geochemical framework for industrial biochar applications and potentially the contribution of carbon to the evolution of our oceans.

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