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"REACTIVITY OF BIOCHAR AND IMPLICATIONS FOR METALS AND CONTAMINANT TRANSPORT"

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The past decade has seen a dramatic increase in research on biochar – the product of the pyrolysis of numerous types of biomass – for purposes including carbon sequestration, water and soil decontamination, and agricultural soil amendment. Recent literature has shown that the affinity of biochar toward potentially toxic metals (e.g., lead, arsenic, selenium, chromium, and cadmium) can be similar to that of graphene oxides and activated carbon. In extended applications to agricultural fields, biochar can control the bioavailability of these metals while simultaneously promoting soil and rhizome microbial communities that are beneficial to crop growth and yield. Despite this promise, understanding the surface reactivity of biochar in dynamic environments is challenging because it is comprised of a complex assortment of organic and inorganic compounds whose distribution depends on the pyrolysis conditions and chemistry of the parent biomass. Here, I will discuss the development of flexible and predictive surface complexation models to understand the reactivity of biochar toward metals in natural systems, the use of biochar as a low-cost sorbent in novel water and soil treatment applications, and ongoing research to better understand the implications of both naturally-formed and amended biochar on the transport of contaminants and metals in the environment.

Dr. Alessi (left) Samples for the evaluating sorptive capacity of biochar to remove organic acids and reductively immobilizing metals from oil sands process-affected water and in agricultural settings (right).

Daniel S. Alessi is an associate professor and the Encana Chair in Water Resources in the Department of Earth and Atmospheric Sciences at the University of Alberta, who specializes in environmental geochemistry and geomicrobiology. Since 2013, his research group has focused on understanding the surface chemistry and reactivity of environmental materials such as iron oxides, bacteria, and biochar, on lithium extraction from oilfield brines, and on improving our knowledge of the water cycle in unconventional oil and gas operations.

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