PROJECT SUMMARY

A New Approach to Quantifying the Release of Bioactive Trace Elements from Coal Combustion Products to Natural Waters

In 2008, the USA produced over 136 million tons of coal combustion products (CCP's), of which ~75 million tons were disposed of as waste, largely in landfills. Given that coal can contain relatively high levels of a number of bioactive trace elements, which may be concentrated and solubilized during the combustion process, there is a need to understand the possible environmental impacts of CCP's in terms of the potential release of these chemical species into natural waters. Although numerous studies have addressed the mobilization of trace elements from CCP's in landfill by groundwater and rainwater, there has been little work aimed at quantifying the release of these chemical species from CCP's that are deposited or released into natural waters such as rivers, lakes and reservoirs. Moreover, the batch-leaching type methods that have typically been used to assess the mobilization of trace elements from CCP's in landfill cannot be reliably extrapolated to predict the release of trace elements from CCP's into natural water bodies at high solution-to-particle ratios, due to the likely precipitation of secondary phases during batch-leaching processes. Thus there is a clear need for new techniques to assess the potential release of bioactive trace elements and nutrients from CCP's into natural waters.

We propose to apply a novel flow-through leaching method together with state-of-the-art analytical methods in order to quantify the release (or uptake) of a suite of bioactive trace elements and nutrients (nitrogen, silicon, phosphorous, vanadium, chromium, manganese, iron, cobalt, copper, zinc, arsenic, selenium, cadmium, antimony, lead, mercury, thallium and uranium) that accompanies the deposition of CCP's into fresh waters typical of rivers and lakes in the southeastern United States. The proposed research will produce robust estimates of the fractional dissolution (or uptake) of these bioactive elements for CCP's deposited in natural waters. Our results can then be used to estimate the quantitative chemical impacts of any given input of CCP's to natural waters if the approximate mass of CCP's and volume of receiving waters is known, thus providing a means to (1) assess the potential biological impacts of CCP pollution, based on the known thresholds of elements to act as toxins and/or nutrients in aquatic environments, and (2) potentially identify and distinguish CCP-derived pollution in natural waters. The proposed work will be undertaken at Old Dominion University, where it will comprise the major portion of a PhD research project.