Redox Mapping of Cr(VI) and Cr(III) in Biochar Particles using Confocal Micro-X-ray Fluorescence Imaging

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Redox mapping, one type of chemical mapping using X-ray absorption spectroscopy, is used for speciation mapping of thin-sections using traditional X-ray fluorescence (XRF) mapping. However, the obtained maps do not provide depth information of the element of interest. In this study, confocal micro-X-ray fluorescence imaging was employed and a procedure was developed for data collection and processing of redox mapping. A biochar particle loaded with Cr(VI) was characterized used the developed method. Linear combination fitting was implemented for the spectra from every location of the mapping area, and the percentage and absorbance of every Cr species were determined for each location. The results showed Cr(III) was the primary form (60-100%) that was greater in interior pixels than at surface, whereas the percentage of Cr(VI) was greater at the surface compared with the interior. The results indicate Cr(VI) stabilization processes using biochar involved adsorption and reduction, and reduction dominanted. The method can also be applied to data collection and processing of redox or chemical mapping obtained using conventional μ-XRF and for other elements. The method can potentially be applied in chemistry, biology, and the material, earth, and environmental sciences.