

Imaging Trace Elements in the Geosphere with Synchrotron-Radiation based X-ray Fluorescence Microscopy

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Synchrotron radiation sources are ideal for developing ultra-bright, highly-focused X-ray probes for characterizing the speciation, transport and reactions of trace elements in heterogenous earth and environmental materials. In particular, micro-XRF allows one to image and quantify the distribution of trace elements in samples with detection sensitivities at the attogram level. Micro-XAS analysis allows one to quantify oxidation state ratios in heterogeneous materials at spatial resolutions less than 1 micrometer. Coupled X-ray-fluorescence, -spectroscopy and -diffraction analysis allows one to quantify the abundance and speciation of elements at trace concentrations and evaluate the mineralogy to which they are adsorbed or bound. Such information is crucial in understanding element cycling in the environment, mobility and toxicity of contaminants, and mechanisms of nutrient uptake and partitioning in plants and other organisms. Applications of X-ray fluorescence microscopy in the Earth and Environmental Sciences will be presented.