Geophysical Research Abstracts
Vol. 14, EGU2012-13769, 2012
EGU General Assembly 2012
© Author(s) 2012

Joining NanoSIMS and STXM/NEXAFS to visualize soil biotic and abiotic processes at the nano-scale

J. Pett-Ridge (1), M. Keiluweit (2), J. Bougoure (1), P.K. Weber (1), M. Kleber (2), and P. Nico (3)

(1) Lawrence Livermore National Lab, CA United States (pettridge2@llnl.gov), (2) Oregon State University, Corvallis, OR, USA, (3) Lawrence Berkeley National Lab, Berkeley CA, USA

Understanding the fate and residence time of organic matter in soils is important to natural resource management, including strategies to mitigate climate change. The time scales of carbon cycling, the relative importance of biotic and abiotic processes in organic matter stabilization in soils, and spatial factors in these processes are all critical characteristics that currently cannot be addressed by any single analytical approach. Here we demonstrate how many of these concerns can be approached by a combination of high-resolution secondary ion mass spectroscopy (NanoSIMS) and Scanning Transmission X-ray Microscopy (STXM) coupled with Near Edge X-ray Absorption Fine Structure spectroscopy (NEXAFS). When used in concert, these analytical techniques have the capacity to yield quantitative, in situ information on the source, molecular class, and elemental quantity of organic matter. We: (i) discuss the rationale for the joined application of the two procedures, (ii) provide examples for the their combined application, (iii) point out some of the methodological caveats that warrant consideration, and (iv) provide some directions for future developmental efforts. To illustrate the synergies of this combined approach, we examined organic-mineral associations in samples from both an artificial well-defined mixture and an unconstrained natural soil decomposition experiment. Case 1 demonstrates how the joined techniques help to determine modes of interaction between 13C- and 15N-labeled microorganisms and a defined mineral phase;, in case 2 we examine the incorporation of a 15N label into mineral organic associations 12 years after application to a forest soil. This unique analytical combination, the simultaneous application of STXM/NEXAFS and NanoSIMS imaging, has the potential to contribute a mechanistic understanding of sorption, occlusion, and decomposition processes that operate at fine spatial scales in natural environments.