NanoSIMS investigation of arsenic (oxy)anions, sulfur, ferric oxide and organic matter colocalization within wetland soil

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Arsenic (As) is a toxic and ubiquitous element found in the atmosphere, soils, rocks, natural waters and organisms, which can be responsible for severe health problems. The As behaviour in soil is controlled by both pH and redox potential of the medium, as well as the metals and the organic matter concentration. However, which kind of interaction binds both As (oxy)anions species and organic matter needs to be further defined. Recently, Nanoscale Secondary Ions Mass Spectrometry (NanoSIMS) analysis allows to map several elements and organomineral assemblages and their isotopic composition as well, whereas preserving the intact spatial structures. Here, with a PTFE plate scavenger, we developed a method to collect freshly precipitated ferric oxides (FeO), while preserving their interactions in a natural wetland environment without any soil matrix disturbance. Average concentration factors for the metallic elements are approximately 99. Our method allows the nanoSIMS imaging on natural colloids-sourced mixed precipitates of ^{75}As, $^{56}Fe^{16}O$, and organic matter ($^{12}C^{14}N$). The colocalizations of the elements show higher correlations between $^{56}Fe^{16}O$, ^{75}As and sulphur (^{32}S). A multidimensional correlation by principal component analysis (PCA) supports these evidenced colocalizations. Whereas ^{32}S, $^{56}Fe^{16}O$ are the first components that drive ^{75}As distribution, $^{12}C^{14}N$ can also be colocalized with ^{32}S and $^{56}Fe^{16}O$ (between 12 to 74%). The colocalization between ^{32}S and ^{75}As could be further investigated to elucidate whether ^{75}As could be associated directly or indirectly with ^{32}S. In that way, ^{75}As might be sequestered through the formation of bonds between ^{75}As and organic sulphur group or cationic iron bridge.