Contribution ID: **79** Type: **not specified**

Detection of engineered cerium oxide nanoparticles in soil

Wednesday, 11 March 2015 11:00 (20 minutes)

The detection of engineered CeO2-NPs in complex natural media is very challenging due to the low expected CeO2-NP concentrations and the comparatively high background of Ce-containing minerals of similar size range. We here present a new analytical method, based on single particle (sp) ICP-MS analysis for identification and quantification of engineered cerium oxide nanparticles (CeO2-NPs). We expect pulse signals of natural Ce-containing particles to be low and to not represent the true size of the particles detected by the sp-ICP-MS. In contrast, engineered CeO2-NPs will appear as a spike which is significantly higher than the background signal and can be used to determine the mass and number concentration as well as the particle size of the CeO2-NPs. Our hypothesis was tested with a set of experiments using CeO2-NP-spiked natural colloid suspensions as well as colloidal extracts of a natural soil spiked with CeO2-NPs. With our current single-isotope method in sp-ICP-MS we are able to detect the addition of the two-fold Ce-concentration compared to the background concentration in all types of samples. Multiple isotope techniques are currently investigated to extend our method by enabling the use of elemental ratios on single particle level and improving the detection limits considerably.

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Session Classification: 5B Tracking NM in complex matrices

Track Classification: Parallel session 5B: Tracking NM in complex matrices