

Detection of engineered cerium oxide nanoparticles in the environment

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Cerium oxide (CeO₂) nanoparticles are increasingly used in products such as diesel fuel combustion catalysts. CeO₂ nanoparticle emission into the environment is of concern due to potential ecotoxicological effects. The detection of engineered CeO₂ nanoparticles in environmental matrices poses a challenge due to predicted concentrations in the part-per-trillion range and the differentiation from nanoparticulate Ce-containing minerals occurring in nature.

Data provided by the Forum of European Geological Surveys (FOREGS) show La:Ce ratios of 0.50 ± 0.05 in bulk topsoils and stream sediments sampled across Europe, while engineered CeO₂ nanoparticles exhibit La:Ce ratios in the range of 0.001 to 0.002. Therefore, deviations from the “natural” La:Ce ratio may potentially be used for the identification of engineered CeO₂ nanoparticles in environmental matrices.

Sediment and preconcentrated water samples from uncontaminated sites were analyzed by flow field-flow fractionation (FFF) coupled to light scattering detection and inductively coupled plasma mass spectrometry (ICPMS) to determine size distributions and elemental composition of the natural nanoparticles. Preliminary results show that La:Ce ratios are constant at about 0.5 across the natural nanoparticles from unpolluted streams.

By addition of engineered CeO₂ nanoparticles at various concentrations to the natural nanoparticle suspensions followed by FFF analysis, we probe the sensitivity of the size-resolved La:Ce ratios as a tool for determination of engineered CeO₂ nanoparticles. FFF size fractions were collected and analyzed by single particle ICPMS, with the aim of differentiating between natural Ce-containing suspended particulate matter and engineered CeO₂. The results were compared to samples from potentially contaminated road runoff samples.

Preliminary findings on the strengths and weaknesses of these methods for the detection of engineered CeO₂ nanoparticles in environmental matrices will be presented.

Hydrological change in the Turkana Basin through the termination of the African Humid Period: The lacustrine Sr-isotope record

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At the Termination of the African Humid Period (AHP) important hydrological changes occurred in NE Africa. Lake Turkana in Northern Kenya is one of the larger lakes in the East African Rift Valley and its Holocene history is relatively well studied. The lake dropped by ~ 80 meters at the end of the AHP, presumably caused by a reduced water supply from the Ethiopian highlands, brought to the lake by the Omo River. The Omo River at present supplies more than 80% of the water to Lake Turkana. In the Holocene this situation was different, with significant water supplied to Turkana by two neighbouring Basins: The Chew Bahir Basin to the Northeast and the Suguta Basin to the South.

Here we have analysed the Sr isotope variation of Holocene ostracods and bivalves to identify Holocene changes in water provenance to Lake Turkana. Results show a clear trend in Holocene Sr isotope values. We interpret higher values in the Early Holocene to reflect significantly increased contribution of water from the Chew Bahir Basin. Application of a Sr-isotope mass balance model allowed us to put constraints on the magnitude and rate of hydrological change in Lake Turkana.

The combined signature of Sr- and oxygen isotope variation in Holocene Lake Turkana is in line with a previously postulated increase in rainfall sourced from the Indian Ocean in the Horn of Africa at AHP times.