Exploring the Nanogeochemical Environment Using single particle ICP-TOF-MS

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With the increasing need to better assess the potential risks that nanomaterials pose to human health and the environment, new techniques and methods capable of detecting and characterizing nanomaterials in complex matrices were needed. Subsequently, single particle ICP-MS was developed and proved capable of assessing nanomaterial behavior at environmentally relevant concentrations (ng L -1) and in complex matrices such as biological fluids, wastewater treatment sludge, and colloidal systems in peat bigs, rivers, oceans and many other geochemical systems. However, the conventional quadrupole instruments had been limited to only one element per particle detection events, removing any possibility of distingushing nanoparticles of similar elemental compositions. With the introduction of ICP-time-of-flight-MS (ICP-TOF-MS), nearly the entire mass range (7-250 m/z+) can be detected and quantified on a single particle basis. With this powerful capability, there are now several potential opportunities to rediscover the natural nanogeochemical environment at a scale not previously possible. By examining natural colloids and mineral nanoparticles on a single particle basis, processes such as aggregation, dissolution, sulfidation, and complexation can all be examined in their native media, limiting the possibilty for measurement artifacts. Insight into these processes may help us better understand urgent environmental concerns such as acid mine drainage and colloid-facilitated transport of toxic metals. Moreover, this method could potential be used to characterize natural environments based of the number and size distrubtion of nano-sized particles, thereby providing an avenue to better assess the sensitivty of specific environments to global change impacts.