The transport of silver nanoparticles from terrestrial ecosystems.

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Silver nanoparticles (Ag-np) are increasingly being used in consumer products presenting the risk of being introduced into the environment. There is evidence that Ag-np are introduced to terrestrial ecosystems through the application of wastewater treatment residuals, or biosolids, that are found to retain between 80-99% of all Ag-np processed. Such a large amount of Ag-np present in or entering into the environment necessitates inquiry as to how further dispersal may ensue. Water dispersible clays (WDC) can be seen as a gauge for the incursion of these contaminants from terrestrial to aquatic systems and an indicator of possible erosion scenarios. Facets of interest to this study include: collection and analysis of the WDC fractions collected from soils amended with Ag-np containing biosolids, and determination of any auxiliary components in soils, biosolids, and WDC fractions for causal evidence of contaminant transport. Pursuing this project was done by obtaining biosolids from a wastewater treatment plant in Lexington, KY and spiking them with three forms of silver: 10nm, 30-50nm poly(N-vinyl-2-pyrrolidone) nanoparticles, and aqueous AgNO₃. These treatments underwent anaerobic incubation before being applied to two soils of differing physiochemical characteristics in a 1:1 ratio. The two soils are a Loradale sil (Typic Argiudolls) and a Bradson (Typic Hapludult). WDC fractions were collected from each treatment and along with initial and residuals soils analyzed for Ag, C, N, and S. Additional characterization carried out includes X-ray diffraction patterns, thermogravimetric analysis, and scanning and transmission electron microscopy. Preliminary results showed that the WDC fractions collected from all treatments were enriched with Ag on a concentration basis, and can therefore play an important role as Ag-np carriers from soils receiving heavy applications of Ag-BS. Ongoing work is aimed at elucidating the underlying associations and mechanisms controlling the WDC-facilitated Ag-np transport, and the effect of any biogeochemical transformations occurring in the biosolids/soil environment on the toxicity of Ag-np.