Manufactured nanoparticle movement in the groundwaters of a redbed sandstone: laboratory experiments and field observations

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Abstract Production of manufactured nanoparticles (mNPs) is likely to increase significantly in the near future. To investigate mNP mobility in sandstone groundwaters, column experiments have been completed on intact continental redbed sandstone. SiO₂ mNP breakthrough concentrations decrease as ionic strength increases, with reversibility indicating secondary minimum attachment: a maximum retention capacity is observed. In contrast, initial metal oxide mNP breakthrough concentrations in deionized water gradually fall as clogging occurs, mobility being in the order (Si >) Ti, Sb > Ce, Ag: no detectable breakthrough occurs for artificial groundwater solutions, even after many 100s of pore volumes. These results suggest that most particles have limited mobility, consistent with measured ζ potentials, but that remobilization can occur if conditions change. A small proportion of particles appear to be more mobile, and this is confirmed by the presence of small amounts of mNPs in wellwaters.

Key words manufactured nanoparticles; colloids; urban; groundwater