

Tracing TiO 2 nanoparticles in a hard rock aquifer

Lise Cary, Patrick Ollivier, Géraldine Picot-Colbeaux, Philippe Leroy, Jérôme Labille, Hélène Pauwels

▶ **To cite this version:**

Lise Cary, Patrick Ollivier, Géraldine Picot-Colbeaux, Philippe Leroy, Jérôme Labille, et al.. Tracing TiO 2 nanoparticles in a hard rock aquifer. Goldschmidt 2016, Jun 2016, Yokohama, Japan. hal-01284878

HAL Id: hal-01284878
https://brgm.hal.science/hal-01284878

Submitted on 8 Mar 2016

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Tracing TiO_2 nanoparticles in a hard rock aquifer

Lise Cary[1,], Patrick Ollivier[1], Géraldine Picot[1], Philippe Leroy[1], Jérôme Labille[2], Hélène Pauwels[1]*

[1]BRGM, 3 avenue C. Guillemin, BP 6009, 45060 Orléans, France

[2] Aix-Marseille Université, CNRS, IRD, CEREGE UMR 7330, Europôle Méditerranéen de l'Arbois BP80, 13545 Aix-en-Provence, France

The increasing use of TiO_2 nanoparticles (NPs) is inevitably leading to its introduction into different environmental compartments, including soils, surface water and groundwater. Where groundwater is widely used for drinking water, any contamination could have an adverse impact on human health as already shown for TiO_2 NPs on living organisms and human lymphocytes. Consequently, the potential exposure of TiO_2 NPs through groundwater contamination needs to be studied and assessed.

The small-scale tracer experiment conducted in a schist aquifer constitutes an attempt to understand the physical and chemical processes occurring if TiO_2 NPs happen to penetrate in a hard rock aquifer. The schist aquifer can be represented by a dual-porosity medium constituted of fractures with low longitudinal dispersivity in which water and solute transport is relatively fast, and of a network of smaller fissures with high longitudinal dispersivity in which transport is slower.

One of the major results is that TiO_2 NPs were mobile and transferred in a heterogeneous schist aquifer through its conductive zones under aggregate forms. NPs do not penetrate the entire poral network during transfer, especially the one with very low porosity, due to electrostatic interactions between NPs aggregates and rock. During their transfer, a large amount of NPs was also deposited onto the rock surface, i.e. affected by sedimentation, clogging and adsorption. Weakly negatively charged NPs may be adsorbed onto the rock surface and especially on the positively charged iron oxi-hydroxides that coat the main pathways due to natural denitrification process. NPs aggregation is reversible due to the mineralogical heterogeneity of the schist and is likely to evolve rapidly after injection and during transport according to the environmental conditions.

Any modification of the aquifer chemical conditions is likely to impact the groundwater pH, the nitrate content and the denitrification process that controls the precipitation of iron oxides in the flow pathways, and thus change NPs aggregation and sorption.