

## **Fate of TiO<sub>2</sub> nanoparticles in carbonate and silicate aquifers**

RONCHI, B.<sup>1,3</sup>, JORIS, A.,<sup>1,4</sup> MAHY, J.<sup>2,5</sup>,  
HEINRICHS, B.<sup>2,6</sup>, VESCHKENS, M.<sup>1,7</sup>, FRIPPIAT, C.<sup>1,8</sup>

<sup>1</sup>ISSEP, Rue du Chéra 200 4000 Liège Belgium;

<sup>2</sup>ULg, Nanomaterials, Catalysis & Electrochemistry - NCE,  
B6a, 4000 Liège, Belgium

<sup>3</sup>[b.ronchi@issep.be](mailto:b.ronchi@issep.be); <sup>4</sup>[a.joris@issep.be](mailto:a.joris@issep.be); <sup>5</sup>[julien.mahy@ulg.ac.be](mailto:julien.mahy@ulg.ac.be);  
<sup>6</sup>[b.heinrichs@ulg.ac.be](mailto:b.heinrichs@ulg.ac.be); <sup>7</sup>[m.veschkens@issep.be](mailto:m.veschkens@issep.be); <sup>8</sup>  
[ch.frippiat@issep.be](mailto:ch.frippiat@issep.be)

The increasing use of engineered nanoparticles leads to their release in the environment, i.e. in aquifers. However, their transport through aquifers remains unclear up until now. Nanoparticle stability in solutions depends on its surface charge which varies with pH conditions but also on the ionic strength of the solution. Consequently, nano-sized TiO<sub>2</sub> (nTiO<sub>2</sub>) are expected to behave differently in silicate and carbonate aquifers as groundwater chemistry is influenced by the host rock mineralogy. To assess the vulnerability of these types of aquifers to engineered nanoparticles, the stability of nTiO<sub>2</sub> is evaluated in four different types of water pumped from carbonate and silicate aquifers and in Milli-Q water.

A suspension of nTiO<sub>2</sub> (30 g/l, pH 1.3 with HNO<sub>3</sub>) was diluted in each type of water (2 replicates) to reach a concentration of 30 ppm and sonicated at 330W during 3 minutes. These suspensions were then allowed to settle undisturbed for up to 5 days for a stabilisation experiment with daily measurements of Ti concentrations. Diameters of the particles were measured for samples of the first day of the stabilisation experiment but also on a second bench of samples. These suspensions were prepared by diluting the same nTiO<sub>2</sub> suspension in filtered groundwater (0.45 µm).

TiO<sub>2</sub> concentrations in supernatant Milli-Q solution (pH=3.9) were stable during the experiment. In contrast, nTiO<sub>2</sub> concentrations measured in groundwater (pH=7.6±0.5) dropped from 30 ppm to ca 1 ppm in 1 day. Sedimentation rates were slightly higher for water from carbonate aquifers compared to silicate aquifers during the first day. After two days, this difference was already insignificant. Diameters of particles present in the samples were the largest in natural groundwater, smaller in filtered groundwater and the smallest in Milli-Q water. This experiment proved that groundwater composition favours rapid aggregation, the likely effect of pH-conditions and the presence of natural suspended particles. Further analyses are needed to determine how these aggregates behave in the aquifer matrix.