Physicochemical and biological interactions between manufactured nanoparticles and environmental bacteria

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Thanks to their particular properties due to their size, the nanomaterials (dimension < 100 nm) are widely used in many industrial applications. This study is dedicated to a deep understanding of the physicochemical and biological interactions between two cellular models from the environment: Synechocystis (cyanobacteria essential for the biosphere) and Escherichia coli (bacteria of mammalian intestines) with cerium oxide nanoparticles (ex: diesel additive). We showed that the stability, aggregation, dissolution and surface chemistry of nanoparticles in the contact medium, strongly influence the toxicity [1]. The physicochemical interactions (flocculation, adsorption, redox mechanisms) are linked to the presence of exopolysaccharides (for Synechocystis) as natural barrier between the cell wall and the nanoparticles. Moreover, the composition of the nanoparticles dispersion medium has a major influence on the survival and membrane integrity, whereas for E. coli, the nanoparticles are the main culprits for the mortality [2].

[1] Thill *et al.* (2006) *ES&T* **19**, 6151-6156. [2] Zeyons *et al.* (submitted) *Langmuir*.

Carbon dioxide interaction with coal: Organic acid production at low temperature supercritical reservoir conditions

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The buffering capacity of coals at circumneutral pH is very low. As a result, the flooding of coals with carbon dioxide rich fluid is expected to produce an acidic aqueous phase in addition to the supercritical water-rich carbon dioxide phase. At low pH, low molecular weight organic acids within porewater and within the rock matrix preferentially exist in neutral form and are likely soluble in the supercritical phase. Here we describe the experimental interaction between supercritical carbon dioxide and thermally immature coal at 300 bars and 75 C. We also describe a protocol to sample both supercritical and aqueous phases for the chemical analyses of dissolved organic acids. Short chain monocarboxylic acids are measured by HPLC, whereas longer chain mono and dicarboxylic acids are analyzed as n-propyl esters of the organic acids via conventional gas chromatography and mass spectroscopy. The potential carbon dioxide-induced liberation of organic acids from natural earth materials could affect mechanisms of mineral surface reactivity and this process could provide an important, unintended source of labile carbon to the deep biosphere.