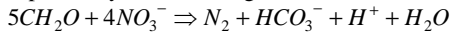


Modelling of denitrification plumes induced by organic matter injection in aquifers

F. GRANDIA, C. DOMÈNECH, S. JORDANA, G. COSCERA, D. ARCOS, L. DURO, J. GUIMERA AND J. BRUNO

ENVIROS-Spain S.L., Passeig de Rubí, 29-31, 08197 Valldoreix, Barcelona, Spain (fgrandia@enviros.biz)

Injection of organic matter can be an effective method for the remediation of nitrate-polluted aquifers. Microbial activity mediates the reduction of nitrate to N_2 by organic matter what can be exemplified by the following reaction:



Nitrate pollution is of special concern in many areas of Catalonia (NE Spain). Although the accepted limit for drinking waters is $50 \text{ mg}\cdot\text{L}^{-1}$, many aquifers in the region contains $[NO_3^-] > 75 \text{ mg}\cdot\text{L}^{-1}$, reaching in some cases up to $400 \text{ mg}\cdot\text{L}^{-1}$. The Catalan Water Agency is presently designing an *in situ* experiment of organic matter-doped water injection in a selected aquifer with high nitrate concentration ($\sim 75 \text{ mg}\cdot\text{L}^{-1} NO_3^-$). The extent and intensity of an aquifer denitrification plume is controlled by geochemical and hydrological parameters and variables (initial injected organic matter concentration, aquifer redox conditions, hydraulic conductivity, dispersivity and porosity).

The denitrifying capacity of the selected aquifer under study was tested in batch experiments in laboratory. From these experiments, a rate law of denitrification was determined and implemented in a series of 3-D reactive transport simulations aimed at selecting the optimal injection conditions, namely the injection rate of the reactive solution, organic matter concentration and injection pulse frequency.. Main parameters controlling the rate law were initial nitrate content, organic matter concentration and temperature.

In the numerical simulations, the total mass of organic matter to be injected ($1.74 \text{ Kg}_{CH_2O}\cdot\text{day}^{-1}$) and total injection time (23 days) were kept constant while different organic matter concentrations and water injection rates were considered. The results show that solutions with organic matter concentration higher than $80 \text{ mg}\cdot\text{L}^{-1}$ at injection rates from 5000 to $20,000 \text{ L}\cdot\text{day}^{-1}$ generate a durable denitrification plume (> 50 days under the maximum limit of nitrate concentration). Injection of water with lower CH_2O concentrations and higher injection rates leads to larger plumes but with lower denitrification intensity. The *in situ* test will also characterise aquifer properties such as depth-related redox conditions and the aquifer parameters given that the injection rate and the extent of the denitrification plume does not only depend on the geochemical variables but also on the ground water velocity.

U-series isotopes in suspended sediments of the Himalayan rivers

M. GRANET AND F. CHABAUX

Centre de Géochimie de la Surface, CGS-EOST UMR 7517, 1 rue Blessig, 67084 Strasbourg Cedex, France (mgranet@illite.u-strasbg.fr; fchabaux@illite.u-strasbg.fr)

Geochemical analysis of river sediments allows to study and quantify the parameters which control erosion and weathering processes at the scale of the watershed. In particular, ^{238}U - ^{234}U - ^{230}Th - ^{226}Ra disequilibria are useful in supplying constraints on the time-scales of erosion and weathering processes (Granet *et al.*, *subm.*; Chabaux *et al.*, 2003).

Previous studies were carried out on different kind of sediments: bedloads and river bank sediments (i.e. Granet *et al.*, *subm.*), and suspended materials (i.e. Dosseto *et al.*, 2006). These works highlight quite different U-Th-Ra values for coarse sediments and suspended materials, which still need to be explained in order to propose robust time-scales of erosion and weathering processes.

Here we analysed U-Th-Ra disequilibria for all the solid phases carried by the Ganges river and its tributaries to understand the relationships among the different kind of sediments: river coarse sediments (Granet *et al.*, *subm.*) and suspended materials sampled at different depths in the water column.

U-Th-Ra analyses of samples collected at the same location highlight a wide range of values from the coarse sediments to the surface suspended materials. The chemical heterogeneity is explained by the fact that the U-Th-Ra composition of the suspended materials is the result of a mixing between coarse sediments and fine materials collected at the same sampling location but which have different origins at the scale of the Ganges basin. The data allow to conclude that the fine materials originate from the Ganges alluvial plain where they have been trapped before to be reworked and carried by the rivers.

The chemical differences observed between suspended materials and river coarse sediments are due to their different origin and history. This certainly accounts for the different time-scales of transfer proposed for these solid phases: long times of about 100^3 s ka for the coarse sediments (Granet *et al.*, *subm.*), and, in agreement with the mixing scenario, short times for the suspended materials.

References

- Granet *et al.*, *subm.*
 Chabaux *et al.*, 2003. *Reviews in Mineralogy and Geochemistry* **52**, 533-576.
 Dosseto *et al.*, 2006. *Earth and Planetary Science Letters* **248**, 759-771.