1-D REACTIVE TRANSPORT MODELING TO EVALUATE THE INTERACTION AMONG DIFFERENT COMPOUNDS IN A COMPLEX CONTAMINATED SITE DRIVEN BY REDOX PROCESSES

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The redox processes are the main drivers that condition the behaviour of different compounds within a plume in a contaminated site. The fuel-derived organic compounds (BTEX and MTBE), that can be released in the aquifer through an oil spill, trigger in groundwater heavy redox condition. This is due to the direct mineralization of organic matter (Palmucci et al., 2016) or to the mineralization of fermentation by-product (e.g. H_2, Acetate, Phenol, etc.), that represent the substrate for microbial growth (Watson et al., 2003; Chambon et al., 2013). When a contamination by chlorinated ethenes (i.e. PCE, TCE, DCEs, VC) also occur, the reductive dechlorination process, which leads to their degradation, can be inhibited by others redox-sensitive compounds (i.e. NO_3^-, Mn(III,IV) hydr-oxides, Fe(III) hydr-oxides, SO_4^{2-}, etc.) naturally and/or anthropically present in the aquifer, because of the competition among the corresponding microbial species (McCarty, 1997; Chambon et al., 2013). The modeling of reactive transport, considering and comparing different kinetic degradation equations (e.g. first-order equation, Monod equation, etc.), can be considered an up-to-date method to understand in detail the processes occurring within the plume, in order to evaluate the best remediation technique.
As study area, a coastal aquifer has been selected, where 10-15 meters thick sandy and silty sandy deposits aquifer overlays an clayey aquiclude (Desiderio & Rusi, 2003; Di Curzio & Rusi, 2016). Here, several foundry wastes burials, an oil spill from a fuel station tanks and a residual chlorinated solvents residual phase were detected.
The reactive transport has been simulated along the main flowpath (1-D model) using Phreeqc (Appelo & Postma, 2005) and the dataset used for the model validation consists of chemical analyses made on groundwater samples collected in a 43 wells monitoring network.
The first results show a persistence of reductive dechlorination by-products (i.e. DCEs and VC) in groundwater near one of the largest discovered foundry wastes burial containing Mn and As-rich Fe hydr-oxides. Thus, the higher is the metals' content in the solid matrix, the slower is the progress of reductive dechlorination, suggesting a strong competition for the substrate among the different microbial species.

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