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Murray, Alexandra Marie; Broholm, Mette Martina; Badin, Alice; Holliger, C.; Hunkeler, Daniel; Maillard, J; Binning, Philip John

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A Plume Scale Model of Chlorinated Ethene Degradation

A. MURRAY[1]*, M. BROHOLM[1], A. BADIN[2], C. HOLLIGER[3], D. HUNKELER[2], J. MAILLARD[3], AND P. BINNING[1]

[1] Water Resources, Technical University of Denmark, Lyngby 2800, Denmark (*correspondence: almu@env.dtu.dk)

[2] Centre of Hydrogeology, University of Neuchâtel (UniNE), 2000 Neuchâtel, Switzerland

[3] Laboratory for Environmental Biotechnology, EPFL-ISTE-LBE, 1015 Lausanne, Switzerland

Although much is known about the biotic degradation pathways of chlorinated solvents, application of the degradation mechanism at the field scale is still challenging [1]. There are many microbial kinetic models to describe the reductive dechlorination in soil and groundwater, however none of them have a degree of accuracy suitable for engineering purposes [2]. The objective of this project is thus to advance models of plume scale transport of chlorinated solvents in order to simulate state of the art field data.

The studied case is located at Fladehøjvej 1, Rødekro in Southern Denmark. PCE has leaked from a dry cleaning facility, and a 2 km plume extends from the source in an unconfined aquifer of homogenous fluvio-glacial sand. The area has significant iron deposits, most notably pyrite, which can abiotically degrade chlorinated ethenes. The source zone underwent thermal (steam) remediation in 2006; the plume has received no treatment. The evolution of the site has been intensely documented since before the source treatment. This includes microbial analysis – Dehalococcoides sp. and vcrA genes have been identified and quantified by qPCR – and dual carbon-chlorine isotope analysis [1].

This work combines batch and transport models using the software FeFlow and PHREEQC to model chlorinated ethene degradation at the Fladehøjvej site. The dechlorination element of the model is incorporated as monod-kinetic reactions [3]. The simulation will also account for the effect of competition for hydrogen as an electron donor with bacteria that utilize other electron acceptors [4].

At the time of the conference, the model developments will be presented. The results will increase the understanding of complex degradation processes within chlorinated solvent plumes.

[1] Hunkeler, *et al.* (2011) *J. Contam. Hydrol*. **119**. [2] Chambon, *et al.* (2013) *Biotechnol. Bioeng*. **110**. [3] Malaguerra, *et al.* (2011) *Env. Sci. Tech.* **45**. [4] Shani, *et al.* (2011) *Env. Sci. Tech.* **47**.