

From small-scale chemical processes to long-term (radioactive) contaminant migration predictions

J.C.L. Meeussen (**NRG**)

T.J. Schroder (**NRG**)

J.J. Dijkstra (**ECN**)

August 2013

ECN-M--14-007



From small-scale chemical processes to long-term (radioactive) contaminant migration predictions

JOHANNES C.L. MEEUSSEN¹, THOMAS J. SCHRÖDER¹
AND JORIS J. DIJKSTRA²

¹Nuclear Research and Consultancy Group Petten, The Netherlands. (* Correspondence: meeussen@nrg.eu)

²Energy Research Centre of the Netherlands, Petten The Netherlands (j.j.dijkstra@ecm.nl)

Migration rates of (radioactive) contaminants in porous materials, such as soil rock and concrete, are dominated by distribution of ions over pore solution and solid phase. Precipitation and adsorption are small-scale chemical processes that determine the distribution and in this way control migration rates at larger scales. The often multicomponent nature of such interactions results in a strong dependence of single element behaviour on chemical conditions, which complicates the translation of experimental results to field conditions. Credible contaminant migration predictions require a model that contains the major soil reactive phases / surfaces, e.g. the different oxide and organic matter surfaces, dissolved organic carbon, including their mutual chemical interactions in a thermodynamic consistent way[1]. The combined CD-MUSIC model for oxides, the NICA-DONNAN model for organic matter, and the LCD model go a long way achieving this. To accommodate these combined models an advanced numerical framework is required[2]. It is, however, important to realize that whatever the assumed sophistication of the conceptual- or numerical model, careful evaluation of model accuracy is essential for its usefulness in practice. Such an evaluation can only be done by testing the model on truly independent data [3].

[1] Schröder *et al.* (2005), *Environmental Science & Technology* 39, 7176-7184. [2] Meeussen, (2003), *Environmental Science & Technology* 37, 1175-1182. [3] Dijkstra, *et al.* (2009) *Environmental Science & Technology* 43, 6196-6201.



ECN

Westerduinweg 3
1755 LE Petten
The Netherlands

P.O. Box 1
1755 LG Petten
The Netherlands

T +31 88 515 4949
F +31 88 515 8338
info@ecn.nl
www.ecn.nl

