Geophysical Research Abstracts
Vol. 14, EGU2012-4605-1, 2012
EGU General Assembly 2012

Engineering biomineralised groundwater flow barriers for inhibiting radionuclide transport in fractured rocks

N. Blundell, M. O. Cuthbert, M. S. Riley, S. Handley-Sidhu, and J. C. Renshaw
University of Birmingham, Earth Sciences, United Kingdom (m.cuthbert@bham.ac.uk)

Microbially induced carbonate precipitation (MICP) is a promising engineering solution for inhibiting pollution transport in fractured rocks through permeability reduction of fine aperture fractures surrounding nuclear decommissioning sites or repositories. However, although many batch and column studies of MICP within porous media have been carried out, the method has yet to be successfully applied within fractured materials and upscaled to block and field scales to demonstrate its potential utility.

This paper presents results of laboratory MICP experiments within artificial granite-perspex fractures (30 cm x 10 cm x 150 μm) under flowing conditions using ureolytic bacteria and a 'cementing solution' comprising dissolved urea and calcium chloride. A variety of injection combinations and bacterial/solute concentrations were trialled and changes in hydraulic conductivity of the fractures were measured over time. Injected bacteria were successfully 'fixed' by adding sufficient calcium chloride to encourage flocculation and hence mechanical filtration to trap the bacteria. Observed reductions in hydraulic conductivity of up to 3 orders of magnitude were achieved after 4 x 4 hour phases of injection with a decreasing mass of precipitate with distance from the inlet manifold.

Although the results are very promising, a remaining challenge for successful upscaling of the technique to the field scale is in controlling the spatial distribution of bacterial fixing and precipitation to enable sealing of fractures at larger distances from the point of injection. In comparison to existing grouting techniques, MICP has the advantage of being low viscosity and is therefore potentially useful for very fine scale fractures while also potentially providing greater mechanical strength.