



Contribution ID: 563

Type: Oral 20 Minutes

Pore space sealing using microbially mediated calcite precipitation: a lab to field scale study

Wednesday, 16 May 2018 16:34 (15 minutes)

Microbially driven calcite precipitation (via ureolysis) has shown great potential in a wide range of applications, including solid-phase capture, concrete crack remediation, soil stabilisation and carbon sequestration. Here, this process is investigated as a means of reducing the primary porosity and/or secondary fracture porosity of host rocks surrounding nuclear waste repositories in order to control or prevent radionuclide transport. To determine a suitable field injection approach, a series of bench scale experiments were undertaken in the laboratory. First, batch experiments focussed on the kinetics of calcite precipitation as a function of bacterial mass, urea and Ca^{2+} concentration and anaerobic vs aerobic conditions. Results showed that the ureolytic bacteria performed equally well under both oxygen poor and oxygen rich conditions. In the next stage, flow-through experiments in various media (sand columns, rock cores) were carried out to examine the homogeneity and extent of the pore space fill along the column / core as a function of injection strategies. It emerged that a staged injection strategy, where we alternate between bacterial and reactant injection, yields the most homogeneous calcite fill, reducing overall porosity by up to 45 %. Ultimately, this approach was tested at the field scale, led by University of Birmingham, to seal a fractured rock (dacite) at ~28 m depth, in a quarry in Leicestershire, UK. Within few injection cycles, the single fracture was substantially plugged by calcite, yielding a significant transmissivity decrease over several meters.

References

Acceptance of Terms and Conditions

[Click here to agree](#)

Primary authors: Dr TOBLER, Dominique J. (Nano-Science Center, Department of Chemistry, University of Copenhagen, Denmark); Dr CUTHBERT, Mark O. (School of Earth and Ocean Sciences, Cardiff University, United Kingdom); Dr RILEY, Michael S. (School of Geography, Earth and Environmental Sciences, University of Birmingham, United Kingdom); Dr HANDLEY-SIDHU, Stephanie (School of Geography, Earth and Environmental Sciences, University of Birmingham, United Kingdom); Prof. PHOENIX, Vernon R. (Civil and Environmental Engineering, University of Strathclyde, United Kingdom)

Presenter: Dr TOBLER, Dominique J. (Nano-Science Center, Department of Chemistry, University of Copenhagen, Denmark)

Session Classification: Parallel 8-A

Track Classification: MS 4.05: Biochemical mineral precipitation for subsurface applications