Porosity and fracture sealing in rock with bacterial calcite precipitation: from lab to field trials

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Calcite precipitation by bacteria (via ureolysis) has considerable potential for sealing porosity in rock, thus preventing fluid flow. This process has potential for inhibiting the transport of contaminants in subsurface systems, such as in contaminated aquifers or from geological disposal facilities for nuclear waste and CO_2.

To obtain data to underpin field trials, experiments were undertaken at the bench scale in the laboratory. First, batch reaction experiments were undertaken to explore the performance of the bacteria, *Sporosarcina pasteurii*, under aerobic and anaerobic groundwater conditions. Results indicated this organism was able to precipitate calcite equally well under both aerobic and anaerobic conditions, highlighting its suitability for subsurface biogrouting technologies. Flow through biogrouting experiments in sand columns and sandstone were then performed, examining the extent and distribution of the filled pore space as a function of varying injection strategies. A staged injection strategy alternating between injections of bacteria and reactants ($CaCl_2$ and urea). provided the best results. Field trials led by University of Birmingham were undertaken in fractured rock (dacite) in a quarry in Leicestershire, UK. This resulted in precipitation of a large mass of calcite with a significant reduction in the transmissivity of a single fracture over an area of several m^2.