Abstract **AQUACONSOIL 2013**, Barcelona

Title: **ECOgrout: a sustainable in-situ carbonate-based grouting technology for use in brownfield redevelopment**

Topic A: **Using functions of soil-water systems**

Subtopic A.5: **Eco-engineering**

Presentation: **Oral**

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A new sustainable alternative for in-situ grouting of soils, particularlly at brownfield sites, is being developed, that provides combined potential for the subsurface creation of foundations, sealings as well as removal of volatile contaminants for groundwater. "ECOgrout" as this technology has been named, is based on the coupled reactions of $CO_2$ degassing and the precipitation of carbonates that naturally occurs in caves in the form of e.g. stalagmites, following:

$$Ca^{2+} + 2\ HCO_3^- \rightarrow CaCO3(s) + CO_2(g) + H_2O(l)$$

In nature, this precipitation process typically proceeds at geological timescales, due to the slow inflow of water equilabrated with calcite at $CO_2$-pressures only slightly higher than atmospheric. So obviously, for any practical engineering application of this process, it needs to be accelerated. Therefore, laboratory column experiments were set up using sand and gravel filled columns that were feed with mixtures of aqueous $CaCl_2$ and $NaHCO_3$ solutions to increase the potential for both calcite precipitaton and degassing of the associated elevated $CO_2$ pressures (up to 12 atm). Under these conditions calcite precipitation was shown to be sufficiently fast for practical applications, as shown by the strengthening of multiple decimeters of sediment within a matter of hours. In concurrence, a high intensity of $CO_2$ gas bubbles were seen migrating upward in the column, indicating stripping potential for volatile contaminants. In several column experiments, clogging of pore space due to calcite precipitation resulted in significant reductions in permeability. During batch test it was found that the calcite precipitation rate was mainly a function of the reactant concentrations, but that it could be influenced by adjusting the solution chemistry (e.g. pH). Under field conditions, air stripping might be required to effectively strip the $CO_2$ from the injected solution. Therefore, future research will include the development of a 3D multi-phase (gas-water) reactive transport that will incorporate permeability effects to assess field application of this technology under various conditions. Experimental evaluation of the effectiveness of stripping volatile contaminants with the evolved $CO_2$ gas is also planned.

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