Particle retention on granite in a synthetic fracture flow cell

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The interaction of monodisperse fluorescent carboxylated polystyrene particles (25 nm and 1000 nm in diameter) and natural polydisperse clay particles mainly consisting of illite (~1000 nm; obtained from hydothermal altered natural fractured granite drill cores from Soultz-sous-Forêts; France) with a cut granite surface (Grimsel granodiorite; Switzerland, [1]) is investigated both experimentally and numerically focusing on the effect of residence time, colloid size, colloid type and concentration on particle retention. Long particle residence time are accomplished by stop-flow experiments between 1 h and 24 h. Additionally to the colloid experiments, conservative solute tracer (Amino-G) experiments are performed to characterize the flow and transport conditions. A cylindrical parallel plate type fracture flow cell (diameter 38 mm; aperture 0.75 mm) has been designed for the transport experiments. The artificial fracture of flow cell is sandwich of acrylic glass and/or granite. At the flow cell's outlet the breakthrough curves/residence time distributions are obtained continuously by means of fluorescence spectroscopy and by photon correlation spectroscopy (PCS)/ laser induced breakdown detection (LIBD) and single particle counting (SPC), respectively. All experiments are conducted at pH 5 under low ionic strength (1 mM NaCl). For post mortem analysis of the granitic fracture surface fluorescence microscopy, scanning electron microscopy (SEM) and laser scanning microscopy (LSM) are applied to obtain information on the colloid deposition/attachment behavior and spatial distribution as a function of e.g. mineralogy and/or surface roughness [2]. Results show earlier first arrivals and more pronounced tailings in the measured breakthrough curves for the colloids compared to the conservative tracer. A positive correlation between residence time and particle retention is observed in all experiments. The experimental findings are corroborated by the 2-D and 3-D numerical simulations.

[1] Schäfer, Huber, Seher, Missana, Alonso, Kumke, Eidner, Claret, Enzmann (2012) *Appl. Geochem.* **27**(**2**), 390. [2] Darbha, Fischer, Luetzenkirchen, Schäfer (2012) *ES&T* **46**(**17**), 9378.