The Colloid Formation and Migration (CFM) project at the Grimsel Test Site (Switzerland): Results from the homologue tests

T. SCHÄFER[1], H. SEHER[1], W. HAUSER[1], C. WALTHER[1], C. DEGUELDRE[2], M. YAMADA[3], M. SUZUKI[3], T. MISSANA[4], U. ALONSO[4], T. TRICK[5] AND I. BLECHSCHMIDT[6]

[1]Forschungszentrum Karlsruhe, Institut für Nukleare Entsorgung (INE), Karlsruhe, Germany
[2]Paul Scherrer Institute (PSI-LES), Villigen, Switzerland
[3]AIST, Tsukuba, Japan
[4]Ciemat, Avenida Complutense, 22, E-28040 Madrid, Spain
[5]Solexperts, CH-8603 Schwerzenbach, Switzerland
[6]Nagra, CH-5430 Wettingen, Switzerland

The Colloid Formation and Migration (CFM) project aims at a detailed process understanding of bentonite buffer material stability in contact with a water conducting feature in a crystalline host rock. Focus of the research within this international collaboration is to understand the formation of the bentonite gel layer, the erosion of the bentonite buffer material, the generation of bentonite colloids and their transport in a natural shear zone. Field migration experiments were planned to be conducted under near-natural flow conditions. To overcome the natural gradient towards the tunnel surface the migration (MI) shear zone was hydraulically isolated by installing a sophisticated mega-packer system counteracting the hydraulic heads of the shear zone. The first homologue test (Run 08-01) was performed in a 6.08m dipole test with a conservative tracer (uranine) residence time of 545min (peak maximum). Colloid analysis included LIBD, s-curve LIBD, SPC, PCS, AFM and bentonite colloid quantification via Al analysis by ICP-MS. Surprisingly, the results showed a quantitative recovery of the injected bentonite colloids (within analytical uncertainty) and a high recovery of the homologues Hf (78 ± 6%), Tb (56 ± 9%) and Th (93 ± 6%), respectively. The observed Hf, Tb and Th recoveries can be explained by batch kinetic data on sorption/reversibility. The lack of colloid size chromatography in combination with high colloid recovery indicates a broad channel („highway“) as flow path of Run 08-01. These results will be compared with a second homologue test to be performed under low-flow conditions (higher residence times). Overall, the results obtained so far within the CFM migration experiments and within the former CRR experiments performed in the MI shear zone using different dipole geometries and flow velocities clearly demonstrate the sensitivity of colloid transport on flow path geometry/heterogeneity of the fracture/shear zone.

Cosmogenic depth profile in a moraine foreslope

M. SCHALLER*, T.A. EHLERS AND J.D. BLUM

Geological Sciences, University of Michigan, Ann Arbor, MI 48109, USA (*correspondence: mirjam@umich.edu, tehlers@umich.edu, jdblum@umich.edu)

Depth profiles of *in situ*-produced cosmogenic nuclides have been measured and widely applied for a) age and/or denudation rate determination of sedimentary deposits, b) the study of surface processes, and c) determination of the depth dependence of cosmogenic nuclide production. Here we present a depth profile from a foreslope position of a Bull Lake-age (~140 ka) moraine in the Fremont Lake Area (Wind River Mountains, Wyoming, USA) to study weathering and denudation rates. Majot element analyses at this profile are compared with a moraine crest profile and surface samples.

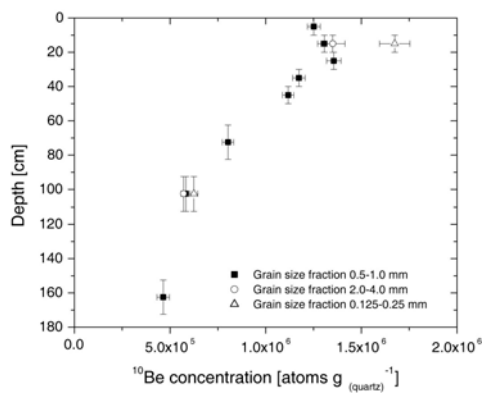

Figure 1: Depth profile from the Bull Lake foreslope position showing the *in situ*-produed cosmogenic nuclides in quartz.

The ^{10}Be concentrations on the slope sample range from 4.64 ±0.33 x 10^5 to 13.6 ±0.4 x 10^5 atoms $g_{(qtz)}^{-1}$. The uppermost three samples (5, 15 and 25 cm) show an increasing cosmogenic nuclide concentration with depth ranging from 12.5 ±0.3 x 10^5 to 13.6 ±0.4 x 10^5 atoms $g_{(qtz)}^{-1}$. Below these three surface samples (>30 cm), the nuclide concentrations decrease with depth.

In combination with grain size and major element analysis we interpret the profile to represent a soil profile overriden by a 30 cm thick moving soil layer. Lateral transport of material down the hillslope is consistent with observed cosmogenic nuclide and major element concentrations. Based on the lowermost three samples and a deposition age of 140 ka, we determine a constant denudation rate of 0.015 mm kyr^{-1} for the soil profile.