RETROACTION OF GEOCHEMICAL PERTURBATIONS AND CRITICAL ZONE MEDIA REACTIVITY ON TRACE ELEMENTS SPECIATION AND TRANSPORT PARAMETERS (C07).

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CONTEXT

Globaly understand the links between surface and subsurface biogeosphere (Critical Zone)

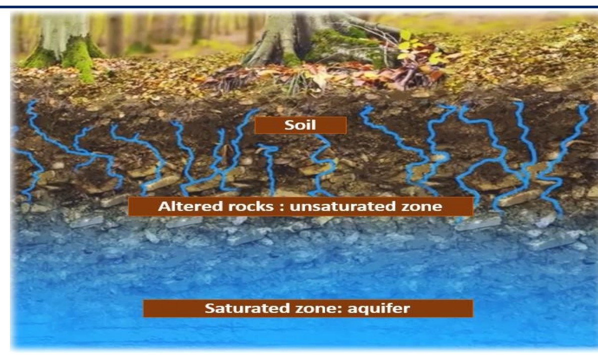


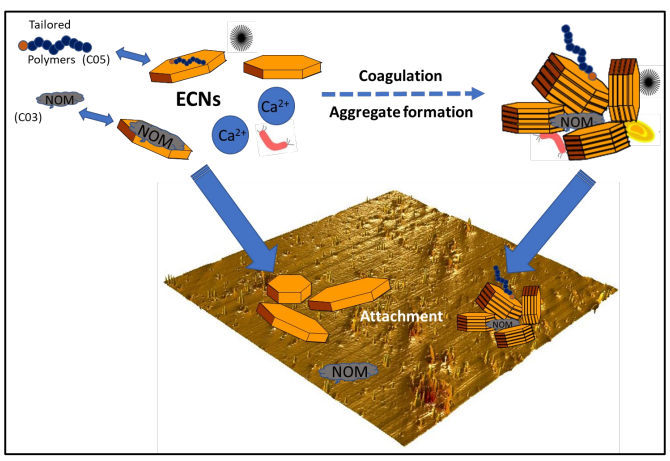
Fig. 1: Critical Zone illustration (aquadiva.uni-jena.de,Video: CRC AquaDiva)

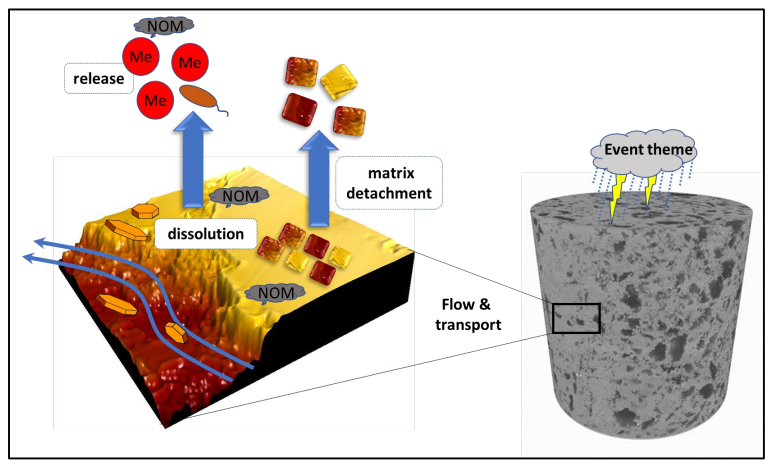
Main Goals:

- Understand the **dynamics, controls, and feedbacks of fluid flow** on colloid-associated **Trace Metals (TM) transport** and **speciation** from surface to subsurface by using **Engineered Clay Nanoparticles (ECNs) as tracer**
- Generalize the **role of local geology/weather events for the subsurface microbiome**

PROJECT PLAN AND HYPOTHESES

Stability and mobility of clay nanoparticles - associated Trace Metals





Current activity:

- synthesise Zn/Ni-montmorillonite (negatively charged) as ECNs.
- Investigate the aggregation kinetics in synthetic water and the well waters from the two AquaDiva sites.

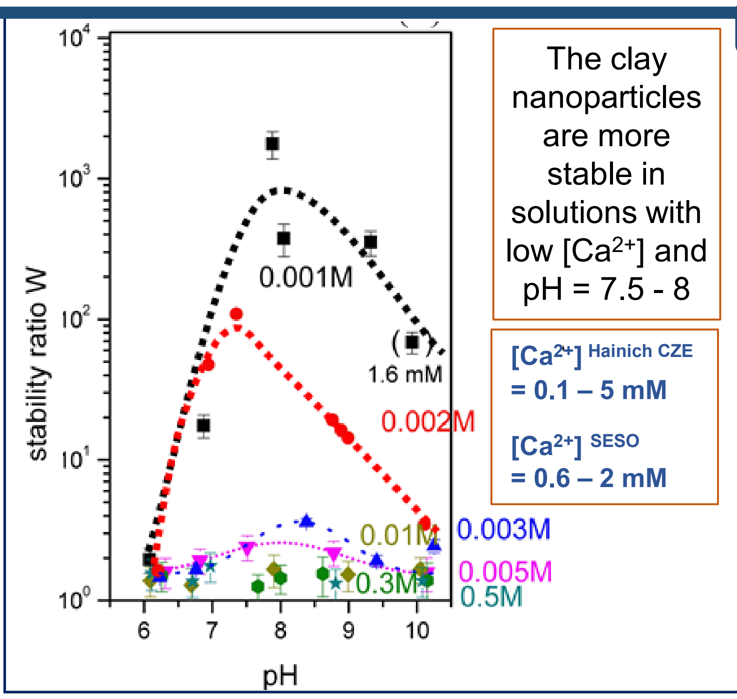
Fig. 2, 3: Schematic illustration of the processes planned to be investigated in the project. (taken from AquaDiva proposal).[3]

- The ECNs stability will be influenced by the local geology and seasons that can probably define the seepages and groundwater physico-chemical parameters (Ionic strength, pH, Natural Organic Mater).

- The fluid flow and the aquifer structure (porosity, fractures) will affect the stability and mobility of the nanoparticles and TM speciation.
- The Clay Nanoparticles will carry TM released by rock material dissolution from the surface to the subsurface.

- The TM speciation will affect the groundwater microbiome.

PRELIMINARY RESULTS



The clay nanoparticles are more stable in solutions with low [Ca^{2+}] and pH = 7.5 - 8

[Ca^{2+}] Hainich CZE **= 0.1 – 5 mM**

[Ca^{2+}] SESO **= 0.6 – 2 mM**

Fig. 4 : Measured stability ratios W of montmorillonite colloids (FEBEX) as a function of ionic strength and pH for $CaCl_2$ solutions (data from Seher et al., 2020).[2]

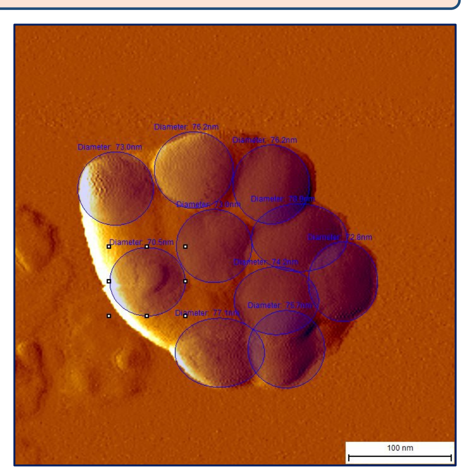


Fig. 5 : AFM image of Ni-Mnt. colloid aggregate with a diameter of approx. 250 nm (Huber et al., 2015).[3]

Larger clay colloids may be aggregates of small particles which are approx. 75 nm in diameter.

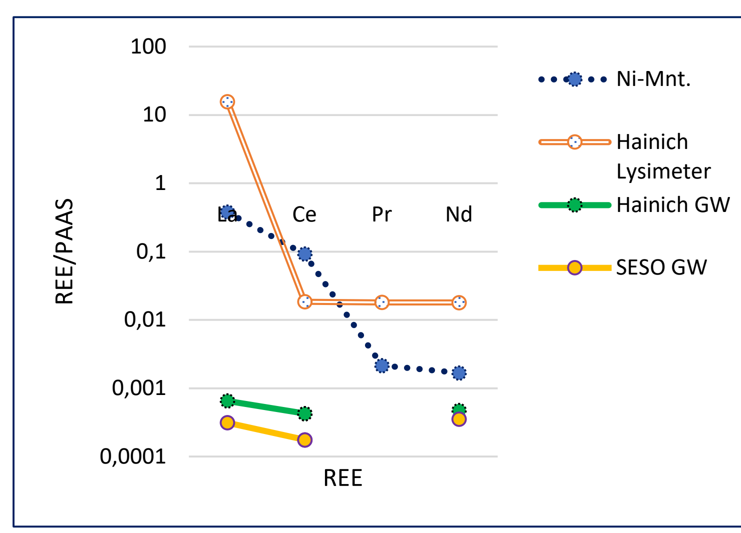


Fig. 6 : REE concentration in Ni-montmorillonite (Ni-Mnt.) ECNs, ground waters (GW) and one lysimeter normalized with PAAS.

Unique REE pattern of Ni-montmorillonite ECNs could be used as additional tracking option.

The REE are below the detection limit in the ground waters except **La**, **Ce** and **Nd**. Their signals in Ni-Mnt. can be used in the groundwater, but not in the lysimeters.

REFERENCES:

(1) *Collaborative Research Centre 1076 AquaDiva. Funding Proposal, third funding period : 2021/2 – 2025/1.*

(2) *Seher et al. (2020) Colloids Interfaces 4, 16.*

(3) *Huber et al. (2015) Geochim. Cosmochim. Acta 148, 426-441.*

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