

# Fungal alteration of organic coatings on sand grains

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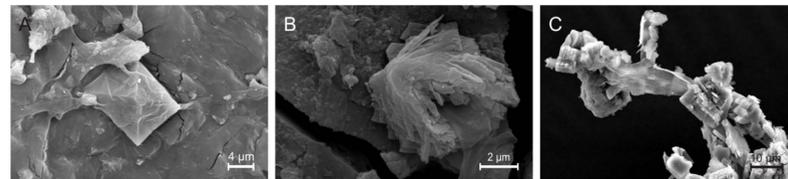
## Aims

We studied the fungal alteration of organically coated sand particles which show high retention ability towards heavy metals. Stability of organic coatings on sand grains has not been assessed yet. Especially in the oxic environment and, more specifically, in the presence of microorganisms, grain coatings might be degraded. This is important in order to evaluate whether coated sands could act as a reliable tool in remediation.

## Material & Methods

Organically coated sand grains were sampled in Eocene sediments in the open cast mining Profen, near Leipzig (Germany). We analysed sand grains coated with organics before and after incubation for 4 weeks at 28°C with the fungus *Schizophyllum commune* grown on agar medium (1 L: 2 g peptone, 2 g yeast extract, 20 g glucose, 0.5 g MgSO<sub>4</sub>·7H<sub>2</sub>O, 0.5 g KH<sub>2</sub>PO<sub>4</sub>, 1 g K<sub>2</sub>HPO<sub>4</sub>, 18 g agar). We applied several techniques, including focused ion beam (FIB) thinning, scanning electron microscopy (SEM), scanning transmission X-ray microscopy (STXM) and vertical scanning interferometry (VSI).

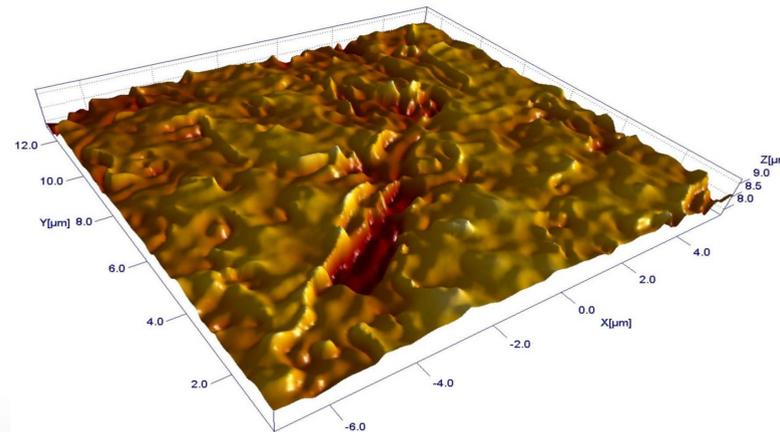
## Results of fungal alteration



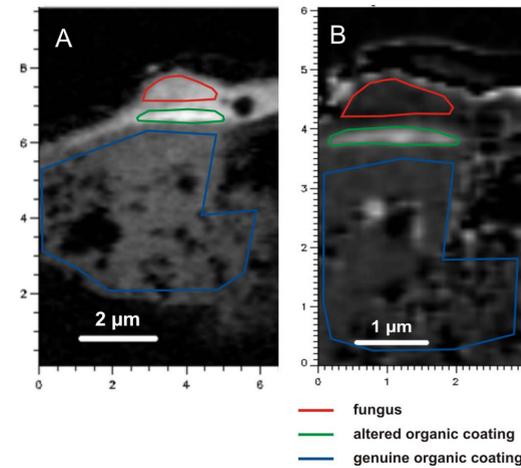
Microbial mediated minerals were induced by the fungal alteration as shown by SEM images. They were presumably assigned to calcium oxalate (Fig. A), silicate (Fig. B) and kaolinite (Fig. C) using EDX spectroscopy.

## Etch pit formation

Surface topography analysis was performed using VSI technique. Etch pit depth ranges from 0.5 to 1 µm and pit formation seems to be limited to the organic coating; dissolution of quartz grains was not detected.

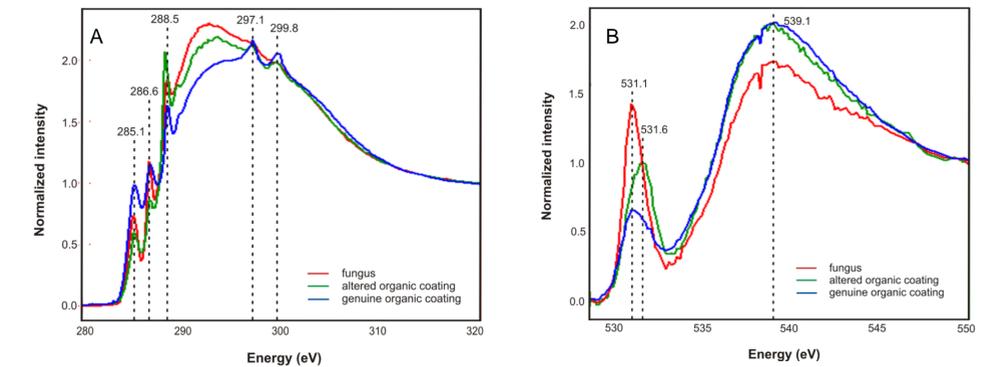


## Altered organic coatings



Distribution maps of carboxyl groups (Fig. A) and nitrogen (Fig. B) were generated by substrating STXM images at 288.47 and 287.56 eV as well as 410.16 and 397.67 eV, respectively. They highlight the altered organic coating between the fungus and the genuine organic coating on sand grains. We obtained near-edge X-ray absorption fine structure (NEXAFS) spectra of all three compartments at the C and O K-edge to identify microbial induced changes.

## Alteration at the fungus-mineral interface



We observed a decrease in aromatic and phenolic groups as well as an enrichment in amide-rich molecules at the C K-edge (Fig. A) on altered organic coating (e.g. Cody et al. 1996, Urquhart and Ade 2002). On spectra at the O K-edge (Fig. B) the altered organic coating contain more carboxyl acid-, ester- and/or amide-rich molecules than the ketonic or aldehydic O-bonds-rich genuine organic coating (Myneni 2002, Urquhart and Ade 2002). *S. commune* seems to excrete proteins at the interface to organically coated sand grains, whereas fungal exoenzymes cleave oxidatively aromatic and phenolic bonds of organic coatings on sand grains.

## Conclusion

Our results suggest biodegradation of organic coatings on sand grains by spatial organized fungal exudation. An important implication might be the overall decrease in metal retention potential of coated sand grains owing to the alteration processes by *S. commune*.

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### References

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Urquhart, S., Ade, H., 2002. Trends in the Carbonyl Core (C 1S, O 1S) -> pi(C=O) Transition in the Near-Edge X-ray Absorption Fine Structure Spectra of Organic Molecules. *The Journal of Physical Chemistry* 106 (34), 85318538.

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“Alteration and element mobility at the microbe-mineral interface”

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