Illuminating the speed of Sand – quantifying sediment transport using optically stimulated luminescence

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Motivation

- Incomplete bleaching of quartz and feldspar is a commonly observed phenomenon in fluvial settings and can be attributed to the attenuation of light caused by high suspended sediment loads and turbidity.
- The fraction of well-bleached grains has been reported to increase with downstream distance.
- Thus, slow bleaching could be used to estimate fluvial transport conditions in terms of suspended sediment concentration and particle velocity.

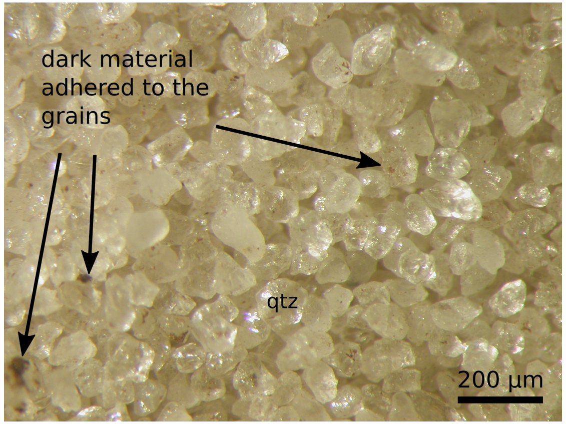
But ...

- …subaqueous bleaching rates are poorly constrained.
- ...wavelength-intensity distribution (spectrum) in turbid suspensions is understudied.

→ Requires bleaching experiments!

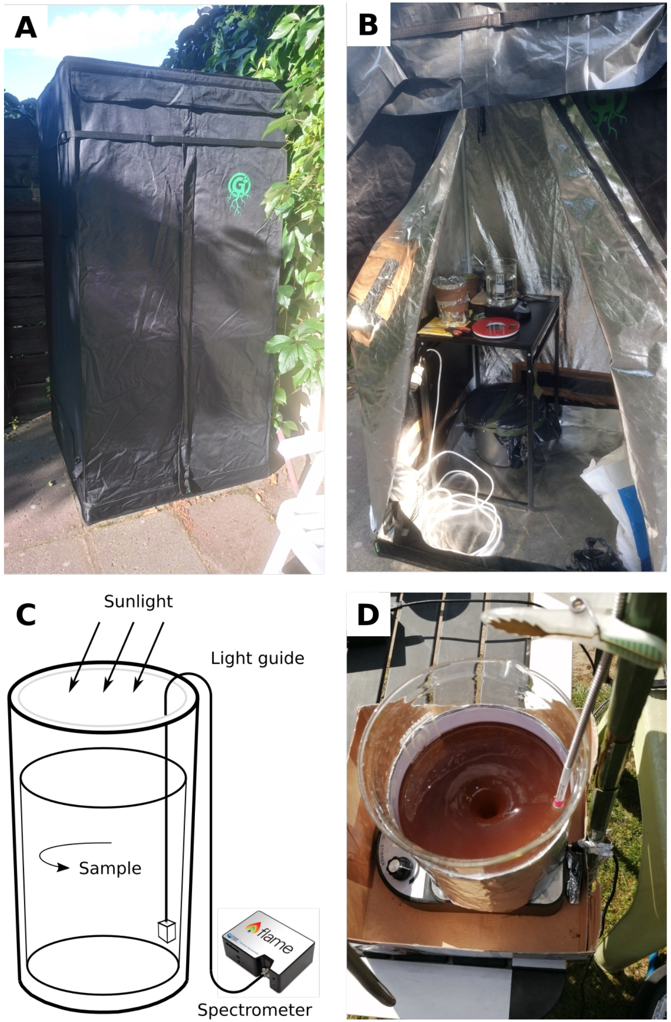
Sampling

- We collected saturated coastal sand of Miocene age from “Grube Gotthold”, an abandoned open pit in southern Brandenburg, Germany.
- All experiments were made with material from the lower horizon (**GG1+GG2**) on the right image.



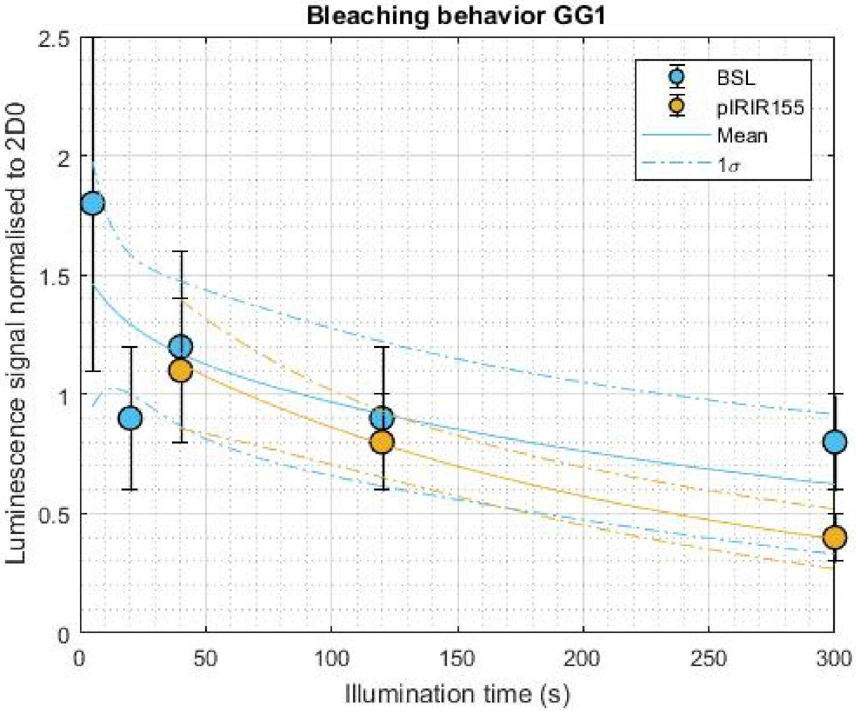
Experiment setup

- We use a circular flume in an outdoor lab.
- Different amounts of sediment is brought into suspension and gets illuminated by sunlight for discrete time intervals.
- We measure the energy-flux density received by the grains using a UV-NIR-spectrometer with a submersible probe.
- First experiment with 100g/l and illumination intervals of 5 seconds to 5 minutes.



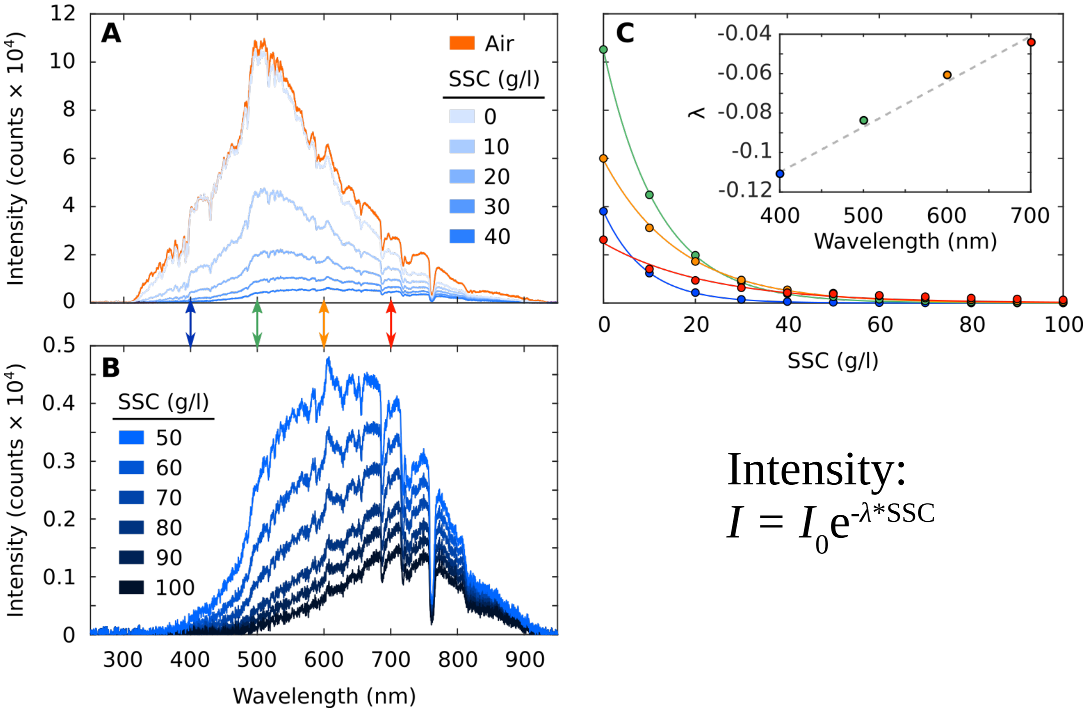
Preliminary results (pre-profiling)

- We analyze the quartz dominated blue stimulated luminescence signal at 125°C (BSL) and the K-feldspar dominated post-infrared infrared stimulated luminescence signal at 155°C (pIRIR-155).
- The BSL appears to decrease slower than the pIRIR155.
- Needs verification using longer illumination times and different suspended sediment concentrations (SSC).



Preliminary results (light spectra)

- We measured the subaqueous light spectra with clear water and suspended sediment concentrations (SSC) of 10 – 100 g/l (**A** and **B**).
- The light attenuation with increasing SSC is wavelength-dependent (**C**).
- UV/blue is filtered out with SSC greater than 40g/l.
- The spectral peak shifts to the red/IR region (**B**).



Intensity:

$$I = I_0 e^{-\lambda * SSC}$$