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!
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:
\[ I = I_0 e^{-\lambda \times SSC} \]