P.10-3: Development of EMCCD approaches for single-grain feldspar measurements and future applications to sediment tracing

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The ability to trace the movement of sediment in nature is key to predicting geomorphic change associated with a vast and diverse range of fluvial, coastal, and anthropogenic processes. In the Dutch Wadden Sea, an ebb-tidal delta nourishment project aims to compensate coastal erosion and prevent drowning of intertidal areas. This provides a unique opportunity to develop and test novel sediment tracing approaches to study nourishment sand dispersal, and to investigate off site geomorphic and ecologic impacts of the nourishment. The TRAILS project seizes these research opportunities through interdisciplinary research, also involving key stakeholders in the Wadden Sea area.

As part of the TRAILS project, we will develop single-grain feldspar luminescence as a sediment tracer. Our key objective is to distinguish two populations of grains (native and nourished) with potentially unique luminescence signatures arising from slow- and fast-to-bleach post-infrared infrared stimulated luminescence (pIRIR) signals. We envisage that our approach may reveal both provenance (deep time) and transport history (modern time) of sediments on a grain-by-grain level, thus providing insight in coastal dynamics and supporting coastal management.

A primary challenge in our work involves obtaining large numbers of informative feldspar signals on a single grain level. To meet this need, the early stages of methodological development for the project focus on the challenges and potential benefits of a novel luminescence imaging system, the electron multiplying charge-coupled device (EMCCD). Grains are stimulated simultaneously and the EMCCD images the resulting luminescence signal, instead of conventional single-grain laser stimulation and detection with a photomultiplier (PM) tube. Similar to conventional single grain methods, EMCCD detection allows rapid repeated measurements without user interference. Moreover, the EMCCD provides extreme low-level light detection for dimmer signals [1]. The EMCCD approach has the additional advantage of simultaneous measurement of all grains on the disc, minimizing thermal erosion during prolonged elevated-temperature post-IR measurements. In addition, the EMCCD camera also enables exploring the TL signals of individual grains [2].

Preliminary results reveal the EMCCD has lower returns than conventional single-grain approaches, whereas the equivalent dose distributions obtained by the measurement devices are similar. This suggests that EMCCD application is promising but requires additional tailoring to meet the aims of our work.

Keywords sediment tracing; nourishment dispersion; EMCCD; pIRIR; degree of bleaching

References

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