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Luminescence signal profiling: a new proxy for sedimentologically "invisible" marine Mass Transport Deposits (MTDs)

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When dealing with fine-grained, organic-rich, colour-monotone, underwater marine sediment cores retrieved from the continental shelf or slope, the initial visual impression, upon split-opening the vessels, is often of a "disappointing" homogeneous, monotonous, continuous archive. Only after thorough, micro- to macro-scale, multi-parameter investigations the sediment reveals its treasures, initially by performing some measurements on the intact core itself, hence depicting for the first time its contents, and subsequently by carrying out the destructive, multi-proxy sample-based analyses.

Usually, routine Multi-Sensor Core Logger (MSCL) measurements of petrophysical parameters (e.g. magnetic susceptibility, density, P-Wave velocity) on un-split sediment cores are the first undertaken while still on-board in the field or back at the laboratory. Less often done, but equally valuable, are continuous X-Ray and CT scan imaging of the same intact archives. Upon splitting, routine granulometry, micro- and macro-fossil and invertebrate identification, total organic / inorganic carbon content (TOC / TIC), amid other analyses take place. The geochronology component is also established usually by AMS 14C on selected organic-rich units, and less common is Optically Stimulated Luminescence (OSL) dating used on the coarser-grained, siliciclastic layers.

A relatively new tool used in Luminescence, the Portable OSL Reader, employed to rapidly assess the luminescence signal of untreated poly-mineral samples to assist with targeted field sampling for full OSL dating, was used for the first time in marine sediment cores as a novel petrophysical characterization tool with astonishing results. In this study, two 2 m-long underwater piston sediment cores recovered from 200 m depths on the continental shelf off-southern Israel, were subjected to pulsed-photon stimulation (PPSL) obtaining favourable luminescence signals along their entire lengths.

Astoundingly, luminescence signals were obtained on both, already split-opened cores. Both cores depicted the monotonous characteristics of homogeneousness down-core as per most of the results obtained from the non-destructive and destructive tests. One of the cores showed several small higher energy events, including a Mass Transport Deposit (MTD) within its first 10 cm, only fully visible on the CT scan imaging, the PPSL profile and particle size distribution plot.

This initial investigation demonstrates the feasibility and usefulness of luminescence profiling as a new sedimentological and petrophysical proxy to better visualize homogeneous yet complex, fine-grained, underwater archives. Moreover, it helps to understand the continuity of the stratigraphy and linearity of deposition of the sediment, besides assisting on the estimation of relative ages provided that good OSL ages are obtained throughout the recovered archive.