Universität Basel

Research Project

Extreme oxygenation stages of muddy sediments recorded by trace fossils

Third-party funded project

Project title Extreme oxygenation stages of muddy sediments recorded by trace fossils
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Department
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Fine-grained deposits that formed under extreme oxygenation conditions are easily recognized by their color: Highly aerobic/oxic conditions lead to red colored sediments (so-called ”oceanic red beds”), whereas oxygen-deficient deposits are characterized by grey to black color (’black shales’). These two types of extremely oxygenated mud normally experience strong compaction and display low color-contrast because of rather uniform composition. Both factors lower recognizability of sedimentary structures in outcrops considerably – probably a reason for the small number of detailed ichnological studies. However, polishing of mudrock in the field has already been proven to enhance visibility of sedimentary structures and will applied during the proposed project. Furthermore, uncompacted structures are preserved in concretions that will be studied. The outcrops proposed to be investigated are located in the Carpathians (Poland) and in the Neuquén Basin (Argentina). They have already been visited cursorily and they are definitely suitable for the proposed investigations.

Burrowing organisms sensitively respond to oxygenation on and within the seafloor. The assemblage of trace fossils, their size, their penetration depth, and spatial arrangement document that bioturbation itself was a major factor in enhancing oxygen flux deeper into sediment. Besides oxygenation sedimentation rate and deposition of organic matter considerably influence the sedimentary record of extreme oxygenation stages. Bioturbational structures are reliable indicators of the depositional environment. For both extreme oxygenation settings general ichnological models exist, whereas detailed studies are only few. To identify variability of the environmental factors, the ichnofabrics of several m-thick intervals will be investigated on a bed-by-bed scale in each outcrop

– to unravel the environmental conditions, under which ’black shales’ and oceanic red beds formed,
– to decipher the amount and quality of the deposited organic matter,
– to deduce the continuity/seasonality of organic matter accumulation,
– to elucidate the processes causing oxygenation on the seafloor due to water-column turn-over, depositional events, or bottom currents, and
– to reveal the relationship between burrowing (bio-irrigation) and early diagenesis causing

– ă complete oxidation of organic matter in oceanic red beds or

– ă partial organic-matter oxidation and precipitation of early diagenetic carbonates in ’black shales’.

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