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Geochemical characterization of sediments from the Benguela upwelling system (BUS): New insights into lithogenic inputs and enrichment mechanisms of trace elements (Ba, U, Ni).

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The Benguela upwelling system (BUS) is one of the most productive marine ecosystems worldwide. The reducing sediments underneath are a major sink for trace elements involved in redox- and bio cycling. Trace elements typically indicate primary redox conditions, organic-detrital inputs or anthropogenic sources. However, for many of these TEs the authigenic sources and accumulation mechanisms are still ambiguous and cannot be ascribed to a single cause. To add to the discussion, we analyzed concentration patterns of U, Ba, Ni, lithogenic tracers (Al, Zr), total organic carbon (TOC) and P in nine multicores from the Namibian central and southern shelf (ca. 23-25°S). Our findings support previous indications that Zr is a very sensitive tracer of the coarse fraction in marine sediment due to frequent dust inputs and/or higher energy during sediment deposition. Hence, Zr/Al and TOC/P ratios allow to differentiate between a rather calm organic matter-rich central shelf and a more energetic phosphorite-rich southern Namibian shelf. Further, high enrichments of U and correlation of U with P in the southern cores suggests an incorporation of U into phosphorites, the initial formation of which requires oscillating oxic to sulfidic redox conditions. Given the U–phosphorite association we suggest U to be used with caution as a primary redox indicator. By contrast, the central cores have variable U/P ratios, which points to organic-detrital, anthropogenic and/or natural U input from coastal lagoons. High enrichment of Ba in Namibian shelf sediments, and correlation of Ba with opal may suggest enrichment due to Ba incorporation into diatoms. Namibian shelf sediments, however, exhibit the same high sulfate reduction rates as e.g. the Peruvian shelf sediments without Ba enrichment. Hence, the P-rich substrates on the Namibian shelf accompanying diatom remains may be an environment to protect barite from dissolution in Namibian sediments. Nickel is enriched in all Namibian sediments. However, determination of the authigenic Ni fraction using lithogenic Ni estimates, which varies regionally is required. Hence, precisely determined authigenic Ni corroborates previous productivity reconstruction.