Trace element fluxes and export production across daily-, seasonal-, and multiannual- timescales in the oligotrophic Gulf of Aqaba, Red Sea

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Real time observations of trace element cycling and distribution patterns between dust, organic carbon particulates, biogenic particles and seawater, in deep open waters are extremely rare, and more so in the context of continuous, highly resolved time series.

We present a record of bulk and export production fluxes, coupled with particulate trace element fluxes in the deep oligotrophic Gulf of Aqaba (GOA), northern Red Sea. The observations are based on a sediment trap array that has been collecting marine particulates at a coupled daily- and monthly- resolution since 2014. The results allow the annual and seasonal patterns to be evaluated in the context of seasonal environmental cycles as well as discrete (daily-timescale) events such as abrupt dust storms, floods and biological blooms.

The trace element composition of several hundreds of sediment trap samples is compared with the geochemical composition of local atmospheric dust and bottom sediments, to (a) deconvolve the sources and sinks in the water column as well as the impacts of biological uptake and regeneration, and (b) characterize the temporal variations in vertical trace element flux patterns and evaluate the remineralizations rates across the annual cycle.

Export production varies seasonaly between winter peak values and summer minimum values. This pattern however, is largely driven by the occurrence of ~2-3 events per year, each lasting a few days (usually during the winter), during which bulk particulate fluxes may increase by an order of magnitude relative to background values, with a corresponding increase in organic carbon and crustal trace element fluxes (e.g., Al, Ti, Fe, REEs), highlighting the critical role of inorganic particulates as ballasts. By contrast, a vertical decrease in the flux of several trace elements (e.g., Cd, Zn, Ba) indicates that despite relatively higher particulate fluxes in the winter, remineralization is more efficient during the summer, when the water column is stratified and most oligotrophic.