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Sedimentary organic matter diagenesis along an oxygen gradient

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Organic matter consists of a complex mixture of different biochemicals exhibiting numerous morphologies and stages of biological oxidation. The degradation process often occurs with oxygen being the oxidant, however, under oxygen-depleted conditions, other electron donors such as nitrate, sulfate, iron and manganese are used to oxidize organic matter. A transect of multicores through the intense oxygen minimum zone (OMZ) in the Arabian Sea shows enhanced preservation of organic carbon within the low bottom water oxygen environment. Previous research showed that lipids are differentially affected by degradation (e.g., Sinninghe Damsté et al., 2002), however, these constituents comprise only a few percent of the bulk organic matter. Based on amino acid analysis Vandewiele et al. (2009) concluded that the organic matter inside and below the OMZ was 'extensively degraded', implying significant microbial reworking of the organic matter even in the absence of oxygen. At depth in the sediment (> 1m) we found that sulfurization of the organic matter took place, which is a potential mechanism to preserve carbon.
Here we investigate relative changes in the composition of the macromolecular (residue after solvent extraction) organic matter in three sediment cores. Cores were recovered from (1) the heart of the OMZ, (2) from the deeper part of the OMZ where oxygen availability is slightly higher than in the upper part of the OMZ, and (3) from sediments below the OMZ where normal oxygen concentrations prevail. In this study we will investigate the early stages (upper 20 cm) of organic matter diagenesis and preservation as affected by the presence or virtual absence of oxygen by analytical pyrolysis techniques.

References

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