Geophysical Research Abstracts
Vol. 13, EGU2011-8922, 2011
EGU General Assembly 2011

The transformation of macromolecular organic matter within and below the oxygen minimum zone in the Arabian Sea.

Klaas G.J. Nierop (1), Gert-Jan Reichart (1), Jaap S. Sinninghe Damsté (1,2)

(1) Utrecht University, Earth Sciences - Organic Geochemistry, Utrecht, Netherlands (k.g.j.nierop@geo.uu.nl), (2) Department of Marine Organic Biogeochemistry, NIOZ Royal Netherlands Institute for Sea Research, P.O. Box 59, 1790 AB Den Burg, The Netherlands.

The Arabian Sea exhibits an extensive oxygen minimum zone (OMZ) which results among others in a high accumulation of organic carbon in sediments that intersect the OMZ. Below the OMZ, the decrease of organic carbon concentrations occurs already to a large extent, while bottom water oxygen concentrations are still fairly small (15 micromoles O_2/kg). To what extent the organic matter composition, and hence it degradability, arriving at the surface of the sediments affects the organic carbon concentrations within the sediments is still a major question in our understanding of organic carbon biogeochemistry and preservation.

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 bottom and pore water 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. The early stages (upper 20 cm) of organic matter diagenesis and preservation was studied by analytical pyrolysis. Six different groups of main pyrolysis products were distinguished: 1) polysaccharide-derived compounds, 2) alkylbenzenes, 3) alkylphenols, 4) alkylpyrroles, 5) n-alkenes/n-alkanes, and 6) pristene/phytadienes. Surface sediments showed relatively similar, highly degraded organic compositions irrespective of bottom water O_2 concentrations, implying that major decomposition took place within the water column. With depth, the relative amounts of alkylbenzenes increased, being more pronounced in the sediment below the OMZ. All other groups of pyrolysis products decreased relatively, apart from the alkylpyrroles within the OMZ. In this sediment alkylpyrroles consisted largely of products derived from tetraalkylpyrrole pigments. Below the OMZ, markers of tetraalkylpyrrole-containing compounds were relatively less abundant and decreased even more with depth, while alkylpyrroles derived from proteins were still present. These data suggest that the bulk organic matter, although degraded already, is diagenetically altered, at the one hand in the same direction, but on the other hand at different rates (more pronounced in the sediment below the OMZ where oxygen penetration extends deeper into the sediment) and divergent with respect to tetraalkylpyrrole-containing pigments.