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Processing of phytodetrital carbon by benthic communities across the Indian margin oxygen minimum zone investigated via in situ isotope labelling experiments

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At present, approximately 6 % of the continental margins (1.5 million km2 of seafloor) experience permanent dysoxic conditions within oxygen minimum zones (OMZs), and this area is predicted to grow as a consequence of climate changes, with major implications for both localized ecosystem function and global biogeochemical cycles. The Arabian Sea OMZ impinges upon the western Indian continental margin at bathyal depths (150 - 1500m) producing a strong depth dependent oxygen gradient at the sea floor. Between October and November 2008, a multi-national expedition led by Prof Hiroshi Kitazato (JAMSTEC) studied the role of benthic ecosystem zonation, oxygen availability and organic matter (OM) availability and characteristics upon carbon and nitrogen cycling. Within this research programme, C and N cycling by the benthic community was investigated by in situ stable isotope pulse chase experiments. Semi-enclosed experimental meso-cosms (Spreaders) were used to deploy doses of 13C:15N labeled Thallassiosira weissflogii, equivalent to 650 mg C. m-2, onto the sediment surface at four stations from the OMZ core across its lower boundary (water depth 540 – 1100 m). 13C and 15N labels were traced into the sediment, bacteria, meio- and macrofauna, and in case of 13C into porewater DIC and DOC.
Here, results on 13C incorporation, respiration and mixing by the bacteria and macrofauna, and preliminary community 13C budgets (excluding foraminifera) are presented. Total benthic and bacterial 13C turnover peaked at 540 m at the centre of the OMZ, where macrofauna were absent due to extremely low oxygen concentrations. PO13C, DO13C and DI13C profiles indicate that very little label was mixed to and respired below 1 cm sediment depth. At the lower boundary of the OMZ (800 and 1100 m) mixing depth increases to 3-5 cm, while overall 13C turnover is reduced and macrofaunal and bacterial contribution 13C uptake/incorporation are roughly equal Polychaetes of the family Cirratulidae dominated macrofaunal 13C uptake. These results indicate that the rates and pathways of carbon cycling across an OMZ impacted continental margin, are strongly influenced by changes in sediment community composition driven by oxygen availability.