Geophysical Research Abstracts,
Vol. 11, EGU2009-10653, 2009
EGU General Assembly 2009

Temperature sensitivity of remineralisation of organic matter in the mesopelagic zone

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Remineralisation of organic matter increases the concentration of dissolved inorganic carbon (DIC) in the mesopelagic zone (100-1000m) where DIC subsequently is transported back to the surface layer through physical mixing and advection processes. Thereby, remineralisation processes working in the upper ocean have a significant impact on surface pCO_2 levels. Heterotrophic processes regulating the remineralisation of organic matter in the mesopelagic zone are expected to be influenced by temperature, and changes in upper ocean temperatures due to climate change therefore can alter the biological drawdown of CO_2 (the "biological pump"). However, this temperature sensitivity of the "deep" part of the biological pump is largely unknown. Here we present and analyse new data for quantifying the temperature sensitivity of remineralisation of organic matter in the global ocean.

We analysed temperature sensitivity of particulate and dissolved organic carbon from the circum navigating Galathea3 expedition (2006-7). Samples of POC were taken from the upper ocean in the Atlantic and Pacific ocean and concentrated by tangential filtration before incubations ($\approx$1 month) in temperature controlled incubators. Similarly, samples of DOC were taken from the mixed layer from the Atlantic, Southern, Indian and Pacific Ocean and also incubated ($\approx$3-4 month) in temperature controlled incubators. Oxygen consumption in the bottles was measured regularly by optode sensors. Remineralisation rates from three temperature levels were subsequently determined by a non-linear fitting method and the temperature sensitivity was quantified in terms of the Q_{10} factor. A significant temperature sensitivity was found for both POC and DOC incubations. The mean value of all POC and TOC incubations gave a Q_{10} value between 2 - 4. These results have implications for the export of organic matter out of the mesopelagic zone, where increased temperatures in the upper part of the main thermocline will increase the total remineralisation of organic matter and thereby the concentration of DIC. Temperature regulated remineralisation of organic matter also have similar consequences for the cycling of carbon and nutrients in a colder climate, i.e. during glacial periods, where upper ocean remineralisation is expected to decrease accordingly.