Spatial patterns of opal and $CaCO_3$ fluxes in sediment traps: Application to the LGM carbon cycle

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Model studies by Archer et al. [2000, 2001] have shown that possibly the most important factor driving interglacial glacial variations in atmospheric pCO_2 is a change in the Particulate Organic Carbon / $CaCO_3$ (POC/PIC) rain ratio to the sediments caused by shifts in the plankton community in surface water. In a recent study of vertical flux composition from deep-sea sediment traps we have shown that deep-sea fluxes of organic carbon are linearly related to mineral fluxes opal, $CaCO_3$ and lithogenic material) with most of the POC export being associated to the flux of $CaCO_3$ to the deep ocean [Klaas and Archer, in press]. Here, we analyze spatial variability of opal / $CaCO_3$ flux ratios from deep-sea sediment trap experiments in an attempt at parametrising export flux of opal and calcium carbonate. Our results indicates that variability of opal / $CaCO_3$ export fluxes shows different trends depending on region. Comparison between $CaCO_3$ and opal fluxes with environmental parameters points toward the importance of temperature in determining the relation between $CaCO_3$ and opal fluxes. In high latitude regions (mean sea surface temperatures below 7°C-10°C) the Si / Ca flux ratios increase linearly with opal fluxes In warmer regions (mean sea surface temperature above 7°C-10°C) $CaCO_3$ and opal fluxes are correlated; a comparison with environmental conditions indicates that $CaCO_3$ fluxes respond to increases in nutrient availability (including iron deposition) as do opal fluxes. We use the results of the sediment trap analysis to constrain variations in the export production of opal/$CaCO_3$ in simulations with the coupled circulation carbon cycle model LSG-HAMOCC2 and the effect of plankton community changes on glacial/interglacial pCO_2 variability.