A New Study on PIC Dissolution and Sinking Fluxes, Concentrations and Calcite/Aragonite Ratios in the North Pacific

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The lack of consensus on $CaCO_3$ dissolution rates and calcite/aragonite ratios in the ocean poses a significant barrier for the construction of global C budgets. We present here $CaCO_3$ lab dissolution rates vs. in situ dissolution rates measured from a N. Pacific transect from Hawaii to Alaska using a ^{13}C labeling technique. We also measured sinking PIC, POC fluxes with sediment traps; suspended PIC, POC concentrations using in situ pumps, and calcite/aragonite ratios along the N. Pacific transect. Samples were analyzed using Picarro, XRD and Raman mapping.

Our results show a general agreement of $CaCO_3$ dissolution rates in the lab vs. in the field when corrected for the kinetic temperature effect and a slow down of dissolution rates due to organic coating. Total C fluxes account for 11~23 weight % of mass fluxes in the upper 200m along the N. Pacific transect, with a PIC/POC mole ratio of 0.2~0.6. Calcite/aragonite ratio is significantly lower in the subtropical gyre (30-70%) than in the subarctic gyre (>80%). A high concentration pool of suspended (30-100μm) PIC is detected in the upper 800m between 20~40°N, yet the highest suspended PIC concentration coincides with the lowest sinking flux at 35°N. This high PIC concentration pool is considered to be a signal of carbonate produced during the summer when the transition zone resided near that latitude. Suspended POC at this latitude, however, does not show a high concentration at mid depth but simply decreases with depth. This implies that there may be a production of shell fragments associated with sinking PIC that persist in waters that are not undersaturated. These PIC particles, if still sinking, are not associated with organic matter. A higher calcite/aragonite ratio is observed shallower compared to deeper, both in sinking and suspended PIC, and also at higher latitude compared to lower latitude. These constraints on the relative fluxes and concentrations of calcite and aragonite will be coupled with the dissolution kinetic measurements to help construct the North Pacific Ocean carbon and alkalinity budgets.