Temporal and depth trends in inositol phosphates in settling ocean particulate matter from Monterey Bay, California

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Phosphorus is recognized as a limiting nutrient in some oceanic systems, and may be the macronutrient most limiting marine productivity over long time scales. Understanding the temporal and depth trends in P concentration and forms is crucial if we are to understand P bioavailability and the role of P in marine productivity. Little is known about organic P cycling in oceans, and less about specific organic P forms such as inositol phosphates. The origins of inositol phosphates in marine environments are largely unidentified. They may be formed *in situ* by aquatic organisms, or they may be transferred from terrestrial environments. The role of inositol phosphates in the marine P cycle is equally uncertain; because they are strong ligands due to high anionic charge, and the phosphate ester linkages are stable in basic conditions, they may be relatively unavailable to aquatic organisms.

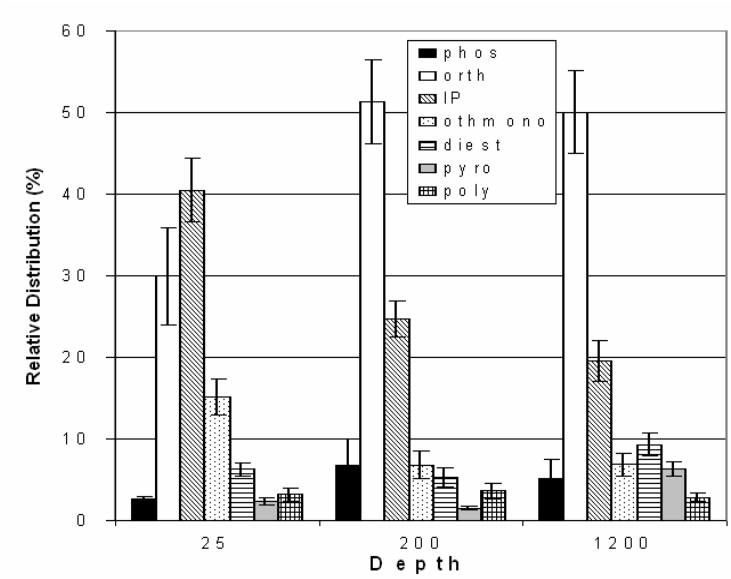

Figure 1. Relative distribution of P forms with depth. Phos is phosphonates, orth is orthophosphate, IP is inositol phosphates, orthmono is other orthophosphate monoesters, diest is orthophosphate diesters, pyro is pyrophosphate, poly is polyphosphate.

We examined the chemical nature of P in settling ocean particulate matter from Monterey Bay, California, using surface plankton tows (25 m depth), IRS trap samples collected biweekly for 6 months at 200 m depth, and Honjo trap samples collected biweekly for 6 months at 1200 m depth. Samples were analyzed by chemical analyses, solid-state ^{13}C NMR spectroscopy, enzyme hydrolysis, and solution ^{31}P NMR spectroscopy. Inositol phosphates were identified as the peaks remaining in the orthophosphate monoester region of ^{31}P NMR spectra after alkaline bromination.

Preliminary results show that inositol phosphates were the largest proportion of P forms (40%) in plankton tows at 25 m, and decreased with depth to 25% at 200 m, and 19% at 1200 m (Figure 1). Some temporal variation in the relative proportion of inositol phosphates was also observed in the 200m and 1200 m samples, but this was generally small compared with variations in the relative proportions of orthophosphate and phosphonates. Inositol phosphates were positively correlated with other monoesters, total C, total N, $\delta^{13}C$, and carbonyl groups (determined by ^{13}C NMR), and were inversely correlated with orthophosphate and with depth.

These preliminary results suggest that inositol phosphates in particulate samples from Monterey Bay are produced by marine organisms and are biodegraded at the surface but become stabilized at depth.