GORDON AND BETTY MOORE FOUNDATION

Team Karl Highlight

Spatial and temporal variability in the turnover of inorganic phosphate and adenosine-5'-triphosphate in the North Pacific Subtropical Gyre

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The microbial community's utilization of inorganic phosphate (Pi) and adenosine-5'-triphosphate (ATP) as a function of the Pi pool concentration was studied over a multi-year period at Station ALOHA (22.75°N, 158°W) in the North Pacific Subtropical Gyre (NPSG). Additionally, the spatial variability in these same properties was investigated along an east-west transect from California to Hawaii in the Fall of 2014. We used radiotracer techniques to determine the turnover times of the Pi or ATP pools respectively, and assessed the Pi hydrolysis rate from ATP.

The Pi-pool turnover time ranged from a few hours to several weeks, and was strongly correlated with measured Pi pool concentrations (r^2=0.8; n=30 Station ALOHA; n=15 transect, Fig. 1). The estimated Pi uptake rates (based on the measured P-pool turnover and Pi concentration) at Station ALOHA averaged 3.7±1.3 nM-P d^{-1} (n=30), reflecting the typically low biomass and low maximum Pi uptake rates of the *Prochlorococcus* dominated community. The Pi uptake rates along the transect were more variable than at Station ALOHA (averaging 9.2±4.7 nM-P d^{-1}, n=15), possibly due to a more diverse planktonic community structure, including stations with elevated concentrations of chlorophyll and primary productivity.

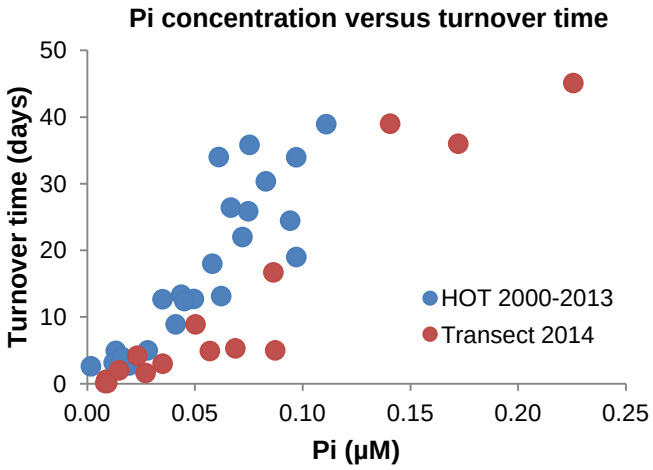

Figure 1. Soluble reactive phosphorus concentrations and turnover time of the Pi-pool as measured by readio tracer techniques.

The turnover time of the dissolved ATP pool was typically substantially shorter than for the Pi-pool (2-5 days at Station ALOHA; 0.3-2.5 days along the transect), likely reflecting its low nanomolar to picomolar ambient pool concentrations. However, at stations with the lowest Pi concentrations the Pi pool turned over more rapidly than the dissolved ATP pool. Furthermore, larger plankton size classes (>2 µm) tended to have longer turnover times for ATP that were comparable to the turnover times of Pi. This suggests that microbial utilization of these two phosphorus pools are independent of one another and that ATP predominantly is processed by the smallest microbial components of this ecosystem. Total ATP hydrolysis was high throughout the transect (~6% h^{-1}), commonly exceeding the Pi taken up by the microbial community, resulting in a net release of Pi into the ambient seawater. At stations with very low ambient Pi concentrations, ATP hydrolysis rates increased but the net Pi released from ATP dimished (Fig. 2). These results indicate that during Pi limiting conditions regenerated P is rapidly consumed, and that Pi limitation oc-

curs locally and transiently but appears not to be the predominant condition in the upper water column of the NPSG.

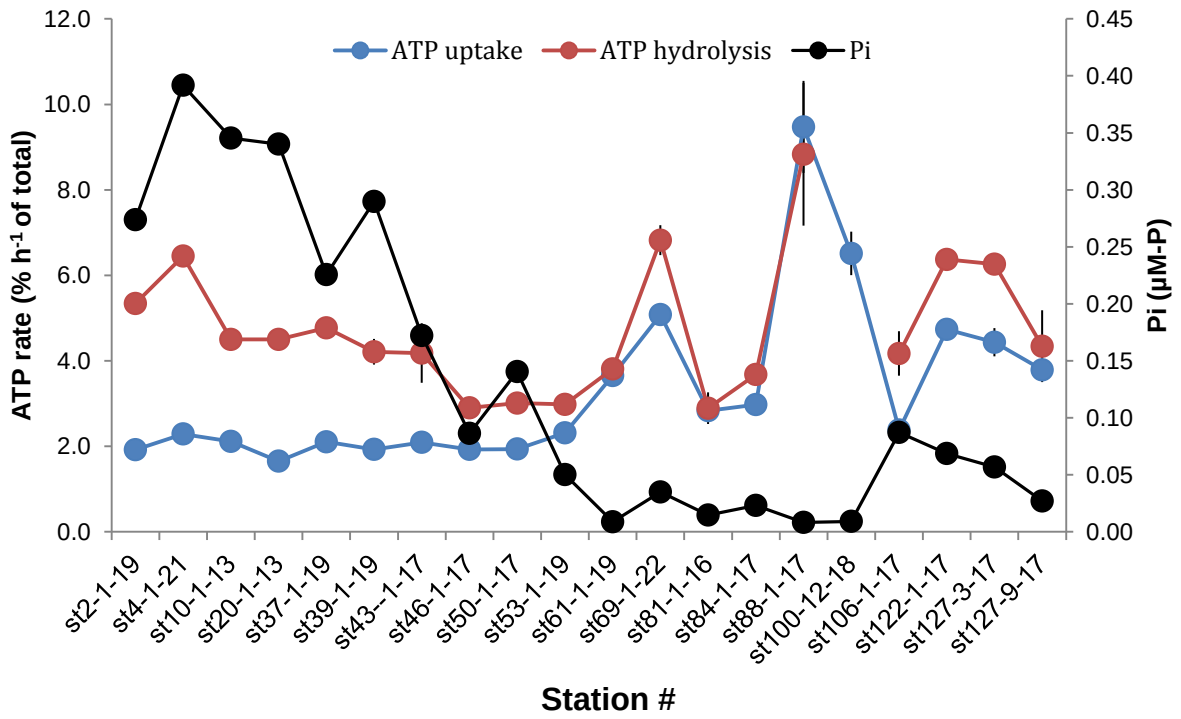

Figure 2. Pi concentrations along a California to Hawaii transect, ATP hydrolysis rates as $\%h^{-1}$ of the total dissolved ATP-pool, and the fraction taken up by the microbial community (>0.2 µm) as measured by radiolabelled ATP.