How POC Export, Curvature in the Martin Function, Biogenic Si Content and Particle Settling Velocity are Related

W. M. Berelson

Department of Earth Sciences, University of Southern California, Los Angeles, CA 90089-0740, USA; Tel. +1 213-740-5828; Fax +1 213-740-8801; berelson@usc.edu

I have examined the fit of the 'Martin Function' to US-JGOFS data from open ocean sites and find that there is a positive relationship between the absolute value of b, expressing the curvature in this power law, and export flux of particulate organic carbon (POC). This implies that sites with the largest export flux of POC are sites where much of this carbon is remineralized in the upper water column. I attribute this relationship to couplings between POC export, biogenic Si content, and particle settling velocity.This relationship is tested with analysis of POC flux vs. depth data from continental margin sites. These regions may be complicated by advective transport, nonetheless, there are data from several margin settings that also indicate a positive correlation between POC export and the b-value. Martin's data from margins support this observation as well.The relationship between POC export, curvature in the Martin function and bSi content is developed when one looks at the bSi/POC ratio in sediment traps from around the globe. At any given site, this ratio increases with depth, suggesting a greater loss of POC relative to the loss of bSi with depth in the ocean. However, there is a systematic increase in this trend; bSi/POC ratios increase more (with depth) when sites are rich in bSi. This pattern could be caused by several processes and mechanisms, but I propose that settling velocity is a major contributor, i.e. sites with more bSi are sites where particles are falling with a lower net velocity. The more time it takes for particles to settle, the more time for differential remineralization rates to modify the bSi/POC ratio.

The velocity—biogenic composition relationship was tested by examining sediment trap fluxes from the Equatorial Pacific. I found that particle settling velocities increase with depth between 1000-4500 m. I also found that during times of greater bSi production, particle settling rates were slower than during times of less bSi production.