Geophysical Research Abstracts, Vol. 7, 02935, 2005
SRef-ID: 1607-7962/gra/EGU05-A-02935

The Ballast Hypothesis

R. Armstrong
Marine Sciences Research Center, Stony Brook University, USA

The ability to predict the delivery of particulate organic carbon (POC) to depth as a function of surface production is a central goal of marine carbon cycle research. In the not-too-distant past, several statistical relationships were proposed to describe this relationship; the most widely used of these is the power law proposed by Martin et al. (1988). More recently, attention has shifted to more mechanistic models. Armstrong et al. (2002) proposed that there is a direct quantitative link between the flux of so-called "ballast" minerals (silicates, carbonates, and dust) and the flux of POC. Shortly thereafter, Klaas and Archer (2002) showed that when silicates, carbonates, and dust were jointly taken as predictors of POC flux, 85-90% of the variance in POC flux could be explained, whereas if only one of these ballasts was taken as a predictor variable, the explained variance was much smaller ($\sim$60%). The "ballast hypothesis" is therefore not simply the notion that mineral matter is needed to make POC sink; that notion is not only trivial, it is also untrue (a fillet of fish will sink quite nicely, as many a distraught fisherman will attest). Rather, the "ballast hypothesis" is that the rain of POC to the deep ocean is determined by, and can (only??) be predicted by, the rain of mineral ballasts. A corollary is that we must be able to predict not only the production of organic carbon, but also the production of mineral ballasts, by both heterotrophs and autotrophs, if we are to be able to predict POC fluxes to the deep ocean. Here I discuss recent progress in understanding the mechanisms that seem to lead to a restricted range of carbon:ballast ratios, despite the large number of factors that might potentially lead to a wider range of values.