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Particulate export vs lateral advection in the Antarctic Polar Front (Southern Pacific Ocean)

T. Tesi, L. Langone, M. Ravaioli, L. Capotondi, and F. Giglio
Istituto di Scienze Marine, ISMAR-CNR, Italy (tommaso.tesi@bo.ismar.cnr.it)

The overarching goal of our study was to describe and quantify the influence of lateral advection relative to the vertical export in the Antarctic Polar Front (Southern Pacific Ocean). In areas where lateral advection of particulate material is significant, budgets of bioactive elements can be inaccurate if fluxes through the water column and to the seabed are exclusively interpreted as passive sinking of particles. However, detailed information on the influence of lateral advection in the water column in the southern ocean is lacking. With this in mind, our study focused between the twilight zone (i.e. mesopelagic) and the benthic nepheloid layer to understand the relative importance of lateral flux with increasing water depth. Measurements were performed south of the Antarctic Polar Front for 1 year (January 10th 1999-January 3rd 2000) at 900, 1300, 2400, and 3700 m from the sea surface. The study was carried out using a 3.5 km long mooring line instrumented with sediment traps, current meters and sensors of temperature and conductivity. Sediment trap samples were characterized via several parameters including total mass flux, elemental composition (organic carbon, total nitrogen, biogenic silica, and calcium carbonate), concentration of metals (aluminum, iron, barium, and manganese), 210Pb activity, and foraminifera taxonomy.
High fluxes of biogenic particles were observed in both summer 1999 and 2000 as a result of seasonal algal blooms associated with sea ice retreat and water column stratification. During no-productive periods, several high energy events occurred and resulted in advecting resuspended biogenic particles from flat-topped summits of the Pacific Antarctic Ridge. Whereas the distance between seabed and uppermost sediment traps was sufficient to avoid lateral advection processes, resuspension was significant in the lowermost sediment traps accounting for $\sim$60 and $\sim$90% of the material caught at 2400 and 3700 m, respectively. Samples collected during high energy events contained benthic foraminifera and exhibited significantly higher 210Pb activity indicating a longer residence time in the water column. In addition, during winter quiescent periods characterized by low mass fluxes, the content of lithogenic particles increased at the expenses of phytodetritus suggesting the presence of lateral advection of fine particles permanently in suspension within the benthic nepheloid layer. In spite of the low mass flux, organic matter content was particularly high during these periods accounting for almost 10% of the global pool of organic matter.