Ocean Iron Fertilisation: ^{234}Th as tracer of export production of POC

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Lohafex, iron fertilization experiment was conducted in a pre-selected eddy in the South Atlantic Ocean from Polarstern from 7 January to 17 March, 2009. The size of the fertilized patch is 300 km^2. An essential parameter to monitor the progress of the induced plankton bloom is the rate at which organic carbon is exported from the surface mixed layer to greater depths. Apart from the measurements by carbon budgets and sediment traps, this carbon export is quantified by the measurement of the depletion of ^{234}Th (half-life 24.1 days) in the surface waters. Repeated measurements of the integrated ^{234}Th depletion allow quantifying the downward flux of particulate ^{234}Th out of the surface water. In order to convert this flux to a carbon flux the POC/^{234}Th ratio of large suspended and of sinking particles is determined.

Profiles of total ^{234}Th from surface to 300 m depth were measured at 21 stations: 2 in the eddy before iron fertilization, 10 in-stations, 5 out-stations and 4 stations outside the eddy. Thorium was collected by coprecipitation with MnO_2 and counted for beta activity onboard to determine the ^{234}Th content. The ^{234}Th export does not show any net change in the ^{234}Th depletion over time and no difference between in and outstations. The depletion in the upper 100m remains at ~5.7 dpm.cm^{-2} corresponding to a steady-state (SS) ^{234}Th export flux of ~1600 dpm.m^{-2}.d^{-1}. With a POC/^{234}Th ratio of ~5 µmol.dpm^{-1}, this amounts to carbon export of ~100 mg m^{-2}.d^{-1}. The time-series observations also allow the calculation of a non-steady state export flux. The result is merely a wide range of fluxes around the SS value, which we interpret to be due to the variability in the fertilized patch rather than to real temporal differences in the flux.

Keywords: Ocean Iron Fertilisation; ^{234}Th; carbon export.