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Investigation of the late summer Si-budget in the Sub-Antarctic and Polar Front Zones south of Tasmania (SAZ-SENSE)

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In the surface ocean, the Si-biogeochemical budget can be estimated by the ratio between the integrated biogenic silica dissolution and production rates. However such data are scarce in the ocean mostly because of methodology limitation. This is especially true in the Sub-Antarctic Zone (SAZ) where only two profiles were measured so far, exhibiting large variation (dissolution: production ratio of 0.3 and 3.1 for spring and summer, respectively). Though, the SAZ plays a crucial role in the efficiency of the silicate pump and the fertility of the Sub-Antarctic Mode Waters which then replenish in nutrients the majority of the surface waters of the world ocean. Therefore, better constraining the dissolution: production ratios in this region will certainly improve our understanding of these processes.

During the SAZ-SENSE cruise (Jan.-Feb. 2007), the Si-budget of three stations (two in the SAZ and one in the Polar Frontal Zone, PFZ, for a total of nine profiles) covering different biogeochemical properties (e.g., Fe enriched vs. depleted conditions, dominance of diatoms vs. other phytoplankton,...) was investigated. This was implemented in the framework of an exhaustive characterization of the Si-biogeochemical cycle using different parameters: PDMPO labelling, 32Si and 30Si spiked incubations, and, taxonomy. We have developed a new method for the determination of the production and dissolution rates from the 30Si isotopic dilution technique. We now measure the changes of the 30Si-abundances in particulate and liquid phases by High Resolution Sector Field Inductively Coupled Plasma Mass Spectrometer (HR-SF-ICP-MS). This method, which is faster, more sensitive and more precise than the traditional ones using an Isotope Ratio Mass Spectrometer (IRMS) or Thermal Ionization Mass Spectrometer (TIMS), will significantly aid in expanding the biogenic silica production-dissolution dataset in the ocean.

The results obtained on Si budget indicate that the Si-regeneration (dissolution) dominates over Si-uptake (production) in the PFZ (1.9 ± 1.5), in contrast to SAZ where production is much larger than dissolution rate (0.08 ± 0.12). The efficiency of the Si-regeneration in late summer seems to be highly variable with significant variations at the same station on short timescale (days). These results will be compared with the other ones obtained from the unique toolbox implemented during SAZ-SENSE to study the Si cycle. They will be discussed to better assess the role of SAZ and PFZ in the global marine Si cycle.