Marine Chemistry

Biogenic and lithogenic silicon along the GEOTRACES south West Indian Ocean section (SWINGS-GS02) and the islands mass effect on regional Si biogeochemical cycle

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The distribution and cycling of biogenic silica (BSi) and lithogenic silicon (LSi) in the ocean play crucial roles in the global silicon cycle and marine ecosystem dynamics. This is especially the case in the Southern Ocean where diatoms constitute the predominant phytoplankton and participate in a major way to the biological carbon pump. This study presents an assessment of BSi and LSi concentrations along the GEOTRACES South West Indian Ocean Section (SWINGS, late austral summer 2021), where several and contrasting regions were encountered: oligotrophic Mozambique basin, HNLC (High Nutrient Low Chlorophyll) areas and regions fertilized by the Subantarctic islands. Suspended particles were sampled from Niskin bottles and in situ pumps, along with scanning electron microscope (SEM) observations and specific pigments measurements to support BSi and LSi analyses. With samples coming from a contrasting study area prone to diverse continental influences, our BSi and LSi results showed a reproducibility of 13 ± 7%, in the same range as the established protocol. BSi concentrations show a north-south gradient with maxima encountered in the Antarctic Zone, and contrasted results between HNLC open ocean areas and naturally fertilized regions in the vicinity of the Subantarctic islands. Some open ocean stations have unusually high BSi (e.g. > 5 μmol L-1) likely resulting from fertilization by aerosols, upwelling or island mass effect when they are downstream of the islands. Coupling of BSi with SEM observations and pigments measurements respectively showed diatoms were the most representative of the carrying phase of BSi and suggested silicification changes, induced either by heavily silicified diatoms or by micronutrient limitation in HNLC regions. BSi is often dominated by the smallest size fraction (0.45–5 μm) which represent 47 ± 23% of the total BSi based on 29 measurements on size fractionated samples. LSi results highlighted atmospheric inputs at the surface and nepheloid layers in the water column, which makes LSi overall a good indicator of the origin of lithogenic materials. SEM observations supported these results, enabling characterization of the diversity of lithogenic materials in the vicinity of the Subantarctic islands, more specifically volcanic ash around Heard Island, and within the nepheloid layers.