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Silicon isotopic contrast between Southern Ocean fertilized and HNLC (High Nutrients Low Chlorophyll) areas: focus around Kerguelen and Heard Islands

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Silicon (Si) is a key element for silicifying marine organisms. Silicic acid (DSi), controls the production of diatoms, predominant in the Southern Ocean. Diatoms are main contributors to the biological carbon pump (BCP), which is particularly active in the Southern Ocean and in areas naturally enriched in iron such as around the Kerguelen and Heard plateaus. Moreover, the BCP is linked to the export of biogenic silica (BSi) to deep waters, via diatom frustules which thus plays a major role on carbon cycle and climate. The objective of this study is to better understand the factors controlling the biogeochemical cycle of Si and its dynamics in the Southern Ocean and how it might be impacted by island mass effect. We use Si isotopic signatures combined with several parameters: DSi, BSi and lithogenic silica (LSi) concentrations, SEM observations of suspended particles as well as pigment analyses. Different oceanic environments were sampled in late summer 2021 during the SWINGS campaign. Here, we focus exclusively on the Antarctic Zone south to the polar front around the Kerguelen and Heard plateaus.Overall, dissolved $\delta^{30}Si$ values are lighter for deep waters and heavier towards the surface as expected from mesopelagic remineralization and isotopic fractionation by diatoms. However, surface $\delta^{30}Si$ values are not homogeneous. Surface $\delta^{30}Si_{DSi}$ values vary significantly (by 0.8‰ and subsurface by 0.3‰) depending on the DSi water mass source. Mixing and upwelling of circumpolar deep water, play a determining role and explain most of this variability. Nevertheless, other significant variations are observed for areas under shelf influence. At Heard the $\delta^{30}Si_{DSi}$ data are homogeneous and lighter by 0.5 to 1‰, along with high LSi concentrations, suggesting a significant contribution of LSi to the DSi pool. This is consistent with SEM observations showing the presence of volcanic ashes. We also observe variations in the $\delta^{30}Si_{BSi}$ signatures. The surface $\delta^{30}Si_{BSi}$ vary strongly ranging from 2.5‰ to 1.0‰ coupled with high BSi concentrations above the shelves (>5 µM at Heard and at depth at Kerguelen). We will discuss the degree of Si utilization, its source in the mixed layer, and its fate along the water column.