Supplementary information

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Si has the highest concentration of all elements in the sediments. On one hand, Si is associated with the flux of terrestrial derived mineral components and on the other hand with siliceous phytoplankton, protozoans, protists, plant phytoliths, and sponge spicules (Croudace and Rothwell, 2015). Si is mainly biogenic in origin in Adélie Basin sediments, dominated by diatoms (Escutia et al., 2011), and contribution of terrigenous Si is low. Therefore, it is used as a proxy for diatom abundance. The record of Si concentrations shows periodic-like variations by a factor of ~ 2 between 21 % and 50 %, with a median of 33 %, corresponding to 70 % SiO_2 or biogenic silica. Concentrations of Al, K, and Ti (as indicators of changes in the flux of lithogenic materials) range between ~ 1.6–7.3 %, ~ 0.37–1.11 %, and ~ 716–1778 mg kg^{-1}, respectively. S and Ca concentrations, which are associated with the biogenic productivity, vary between ~ 0.13–0.87 % and 0.72–1.49 %, respectively. Ca concentration indicates that calcite producing microorganism is of minor importance in Adélie Basin. Concentration of Zn, as a crucial micronutrient for marine phytoplankton which plays physiological roles (Morel et al., 1994), ranges between ~ 96 and 216 mg kg^{-1}. Fe is another essential micronutrient for biochemical processes of phytoplankton such as photosynthesis, respiration, and nitrogen fixation (Lohan and Tagliabue, 2018). Concentration of Fe varies between ~1.05 and 3.46 %, which is similar to other siliceous sediments but lower than reported concentration in other ocean sediments (Chen et al., 1996). Fe concentrations increase at 66.45 m depth to the top of the core by a factor of ~ 1.6 (from a median of ~ 1.50 % below the 66.45 m depth to ~ 2.40 % above the 66.45 m depth). This is attributed to the upward transport of Fe under anoxic conditions. Chlorine was found to be another major component in these sediments. Cl can go through biological pathways (incorporation into algae) and reach the sediments by the fast-sinking detritus (Leri et al., 2015). Concentrations vary between ~ 1.3 and 19 % (with a median of median 4.5 %) and show a decrease from the top to the bottom of the core which is likely attributed to the increasing mineralization of organic matter with age and the release of chloride through reductive dechlorination.

To go further and identify the important elemental relationships, a regression analysis was performed on the elements concentrations as well as their corresponding residuals. The regression results indicated that Si, as a proxy for diatom abundance, correlates with Al, S, K, Cl, and Ti. (Fig. S1). After Si, which has the highest concentration of all elements in the sediments, these elements have relatively higher concentrations than other elements, but still very low. This can explain the found statistical correlation between Si and some elements and not with other elements, owing to the reason that for elements with lower concentrations there has always been excess algal material within or passing through the water column to scavenge/uptake all water column elements. These correlations along with high elements accumulation rates further emphasis

that biological productivity and related scavenging/up taking of water phase elements by diatom particles controlled elements accumulation in Adélie Basin sediments.

References

Chen, S.-Y., Ambe, S., Takematsu, N. and Ambe, F.: The chemical states of iron in marine sediments by means of Mössbauer spectroscopy in combination with chemical leachings, J. Oceanogr., 52, 705–715, https://doi.org/10.1007/BF02239461, 1996.

Croudace, I. W. and Rothwell, R. G.: Micro-XRF Studies of Sediment Cores: Applications of a non-destructive tool for the environmental sciences, Springer., 2015.

Escutia, C., Brinkhuis, H., Klaus, A. and Scientists, E. 318: Site U1357, Proc. Integr. Ocean Drill. Programprogr., 318, doi:10.2204/iodp.proc.318.105.2011, 2011.

Leri, A. C., Mayer, L. M., Thornton, K. R., Northrup, P. A., Dunigan, M. R., Ness, K. J. and Gellis, A. B.: A marine sink for chlorine in natural organic matter, Nat. Geosci., 8, 620–624, https://doi.org/10.1038/ngeo2481, 2015.

Lohan, M. C. and Tagliabue, A.: Oceanic micronutrients: trace metals that are essential for marine life, Elements, 14, 385–390, https://doi.org/10.2138/gselements.14.6.385, 2018.

Morel, F. M. M., Reinfelder, J. R., Roberts, S. B., Chamberlain, C. P., Lee, J. G. and Yee, D.: Zinc and carbon co-limitation of marine phytoplankton, Nature, 369, 740–742, https://doi.org/10.1038/369740a0, 1994.

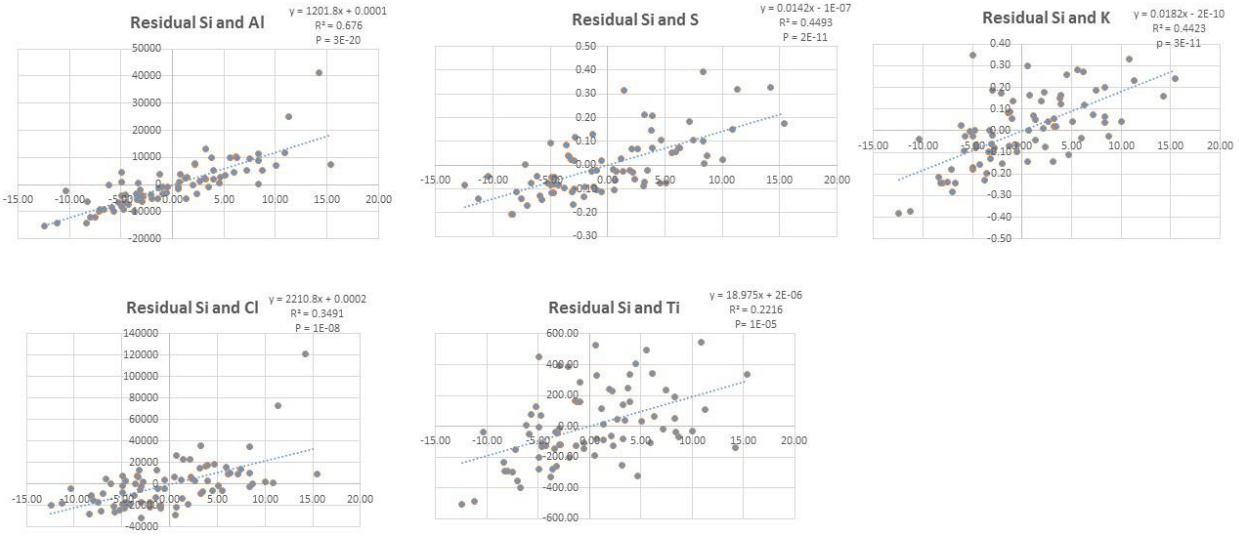

Figure. S1: A regression analysis on the elements concentrations residuals.