Sedimentary nutrient supply in productive hotspots off the West Antarctic Peninsula revealed by silicon isotopes

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The West Antarctic Peninsula (WAP) is a highly productive shelf region during austral summer, where algal production supports a rich ecosystem that has a significant impact on the sequestration of carbon. This rich ecosystem is heterogenous, and characterised by biological "hotspots" dominated by diatoms. However, the specific mechanisms determining the location and the extent of these hotspots are not fully understood. Recent evidence has shown a sedimentary enrichment of silicic acid (DSi) relative to other nutrients along the WAP, suggesting that nutrient transfer across the sediment-water interface could have a major impact on algal community composition.

Here we combine, for the first time, reaction-transport modelling with porewater profiles of DSi concentration and stable silicon isotopic composition (δ^{30}Si), and biogenic silica (BSi) and diatom abundances, from sediment cores collected along the WAP, to assess the DSi flux to the bottom water and the processes that release this key nutrient from the WAP sediment.

The diffusive benthic DSi fluxes from the WAP shelf are lower than the previously calculated values from the open Southern Ocean. Our δ^{30}Si values suggest that porewater DSi concentrations are controlled primarily by BSi dissolution and authigenic formation. Furthermore, the modelling approach highlights the role played by BSi dissolution, and the strong impact of high surface productivity on sedimentary processes and the early diagenetic release of DSi. Taken together, our findings suggest a strong benthic-pelagic coupling of the Si cycle along WAP.