Statement of interest for US GEOTRACES GP17-ANT and GP17-OCE

Impact of high-productivity environmental conditions on sediment Fe fluxes and non-traditional stable isotope compositions (Fe, Cr, U)

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1. Specific research goals

a) Iron fertilization has been proposed as a key mechanism to enhance the biological pump over glacial-interglacial cycles, contributing to enhanced CO_2 drawdown during glacial periods. Traditionally, increased dust flux has been postulated as the primary source of Fe to the Southern Ocean. However, recent studies have highlighted the significant potential for glacial meltwaters and benthic exchange to deliver dissolved Fe to the surface ocean in this region (Sherrell et al., 2015; St-Laurent et al., 2017). Still, Fe fluxes at the sediment-water interface on the Antarctic Shelf are largely unconstrained. ***We propose to measure benthic Fe fluxes (concentrations and isotope ratios) in the Amundsen Sea (section GP17-ANT) from pore water gradients and on-board sediment incubation setups, using sediments collected by the USAP multicorer.*** Our proposal to quantify Fe fluxes at the sediment-water interface will complement analyses of Fe concentrations and isotope compositions in near-bottom water samples collected with the CTD-rosette. Additional TE porewater and sediment concentrations measurements will include, e.g., Mn, Mo, U, Cr, Cu, Cd, Ni, V. Severmann and McManus have significant expertise in the study of benthic fluxes, and Fe and Mn are GEOTRACES key parameters.

b) Chromium isotope compositions of marine sediments—commonly applied as paleo-redox proxies—are currently re-interpreted as potential proxies for bioproductivity. Recent studies link changes in the isotope ratios of Cr to C_{org} burial rates (Janssen et al., 2020), contrasting their original interpretations as redox-proxies. Further, Cr isotopes have recently garnered interest by the GEOTRACES community due to their apparent link to the nitrogen cycle and primary productivity. Both sections (GP17-OCE and GP17-ANT) provide opportunities to sample sites with high productivity (e.g. sub-Antarctic front, Amundsen Polynya) and low productivity (South Pacific Gyre, outer Amundsen shelf). We aim to ***analyse Cr isotopes and their concentrations in seawater as well as underlying sediment samples (upper ~30 cm)***. Bruggmann recently completed her PhD research on the analysis of U and Cr isotope compositions in a range of marine (including seawater) and geological samples.

2. Sample requirements

a) Sediment cores from ~15 sites in the Amundsen Sea (GP17-ANT) for pore water sampling, solid phase sampling and on-board incubations, as well as bottom water samples to investigate benthic Fe fluxes. We anticipate that we will require 3-4 cores per site (using USAP multicorer), one for porewater extraction and 2-3 for on-board incubations. Sediment samples can be shared with other investigators.

b) Up to 1L of seawater samples, and surface sediment samples from a selection of low and high productivity conditions (GP17-OCE and GP17-ANT). We are also interested in particle samples collected with in-situ pumps.

References:

Janssen D. J., Rickli J., Quay P. D., White A. E. and Nasemann P. (2020) Biological Control of Chromium Redox and Stable Isotope Composition in the Surface Ocean Global Biogeochemical Cycles. *Global Biogeochem. Cycles* **34**, 1–18.

Sherrell R. M., Lagerström M. E., Forsch K. O., Stammerjohn S. E. and Yager P. L. (2015) Dynamics of dissolved iron and other bioactive trace metals (Mn, Ni, Cu, Zn) in the Amundsen Sea Polynya, Antarctica. *Elem. Sci. Anthr.* **3**, 1–27.

St-Laurent, P., Yager, P.L., Sherrell, R.M., Oliver, H., Dinniman, M.S. and Stammerjohn, S.E. (2019) Modeling the Seasonal Cycle of Iron and Carbon Fluxes in the Amundsen Sea Polynya, Antarctica. *Journal of Geophysical Research: Oceans,* **124**, 1544-1565.