The unique biogeochemical signature of the marine diazotroph *Trichodesmium*

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Trichodesmium is a globally important nitrogen-fixing, filamentous cyanobacterium. In the present study, we collected *Trichodesmium* colonies from the Sargasso Sea and investigated their elemental signature. Element concentrations and spatial distributions in colonies were compared using inductively coupled plasma mass spectrometry (ICPMS), CHN analysis, and synchrotron x-ray fluorescence (SXRF) mapping. *Trichodesmium*'s cellular stoichiometry of 647C:111N:1P deviated significantly from the canonical Redfield ratio and illustrates the P-limiting condition at the time of sampling. Additionally, ICPMS and SXRF analysis confirmed that the metallome of *Trichodesmium* is enriched in V, Fe and Ni in comparison to other phytoplankton. Surprisingly, V was the most abundant metal in *Trichodesmium*, and the V quota was up to 4-fold higher than the corresponding Fe quota. Furthermore, SXRF mapping revealed the presence of V and Fe hotspots. These hotspots typically spanned over several contiguous cells. The spatial distribution of Ni differed from V and Fe and was enriched in transverse walls between attached cells. As hotspots of V, Fe, or Ni were spatially decoupled from each other, we conclude that external adsorption of aerosol particles on *Trichodesmium* trichomes did not contribute to the elevated element quotas. Fe hotspots were found in only ca. 10% of analysed trichome sections, and Fe enrichment in contiguous cells may be linked to diazocytes as zones of nitrogen fixation in *Trichodesmium*. In contrast, genomic analyses indicated that V is not directly associated with nitrogenase in *Trichodesmium*. V maybe used in V-dependent haloperoxidases to protect the oxygen susceptible nitrogen fixing enzyme nitrogenase from reactive oxygen species (ROS) such as hydrogen peroxide, but genomic evidence for such an enzymatic role of V is also currently lacking. The presence of Ni in transverse walls is in agreement with genomic evidence for the presence of Ni-superoxide dismutase and/or NiFe hydrogenase. Both Ni-containing enzymes are beneficial for nitrogen fixation by either inactivation of the ROS species superoxide or the catalyzation of hydrogen, respectively. We conclude that the enrichment of these metals is directly or indirectly linked to nitrogen fixation in *Trichodesmium*.

Zooming on Heinrich layers H2 to H0 through geochemical and sedimentological analysis of a core raised off Hudson Strait

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The ~ 9 m-long core (HU08-029-004; 2674 m water-depth; 61°27'N, 58°2'W) was raised from the lower slope of the Labrador Sea, approximately 100 nm off the Hudson Strait shelf edge. It provides a high resolution record of recent detrital carbonate sedimentary pulses through Hudson Strait assigned to "Heinrich events" H2, H1, H0, thus the means to constrain the age and depositional mechanism of the corresponding "Heinrich layers" at near proximity of sediment source. Some special attention is given to depositional mechanisms of fine glacial flour reworked by meltwater vs ice-rafted debris (IRD). Analysis includes, at ~ 10 cm-intervals, uranium and thorium series measurements (^{238}U, ^{234}U, ^{230}Th and ^{232}Th), at 4 cm intervals, semi-quantitative analyses of mineralogical assemblages (XRD), inorganic and organic carbon ($C_{inorg.}$, $C_{org.}$) contents and $C_{org.}/N$ data, coarse fraction abundance (>106 μm), which we associate with IRD, CAT-scan images; nine layers provided enough Neogloboquadrina pachyderma (l) shells for ^{14}C measurements. Calibrated ^{14}C ages indicate a mean sedimentation rate of ~ 27 cm/ka, Heinrich-layers included, and of ~ 25 cm/ka when they are assigned a duration from literature data then excluded from the sediment inventory (i.e., "background" sedimentation rate). ^{230}Th-excesses ($^{230}Th_{xs}$) over supported fraction are estimated following Veiga-Pires & Hillaire-Marcel (1999). Preliminary results show that the Heinrich layers contain up to 60% fine detrital carbonates (mostly calcite) and are highlighted by low $^{230}Th_{xs}$ (nearly 0 dpm/g) indicating an extremely fast depositional mechanism of the fine fraction. Coarse fraction peaks highlight intense IRD on both sides of the fine detrital carbonate layer, i.e., from the very beginning until a "late" H-event phase. They likely correlate with the H-layers as observed in more distal North Atlantic sites. $^{230}Th_{xs}$ inventories and background sedimentation rate calculated as above, suggest much higher Holocene $^{230}Th_{xs}$ fluxes at the study site, in comparision to late glacial fluxes, resulting from $^{230}Th_{xs}$-advection by an enhanced Western Boundary Undercurrent.

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[2] Rashid et al. (2003a), *Earth and Planetary Science Letters*, **208**, 319-336.
[3] Veiga-Pires *et al*. (1999), *Paleoceanography*, **14**(2), 187-199.