Global Biogeochemical Cycles

Supporting Information for

Glaciers and Nutrients in the Canadian Arctic Archipelago Marine System

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Additional Supporting Information (Files uploaded separately)

Introduction

Supporting information is provided to augment statements and data provided in the manuscript. Supporting data encompasses additional information for glacier characteristics described in Table 1 in the manuscript (Table S1, Dataset S1), a tally of the number of samples (Table S2), visualizations of oceanographic properties measured along marine transects (Dataset S2), a summary of bottle data (Table S3), a summary of statistical comparisons (Table S4), a visualization of nutrient ratios (Figure S1), and a visualization of metal profiles (Figure S2) presented in this study.

Table S1. Datasets used for basin delineation and glacier metrics terminus length and retreat.

Glacier	Randolf Glacier Inventory ID	LandSat Imagery		
		Path	Row	Date
Belcher	RGI60-03.02442	38	6	13-Jul-99
		92	239	02-Jul-20
Sverdrup	RGI60-03.02435	38	6	13-Jul-99
		41	6	02-Sep-19
Jakeman	RGI60-03.01555	41	5	02-Jul-99
		92	239	02-Jul-20
Sydkap	RGI60-03.01897	48	4	03-Jul-99
		44	5	02-Jul-20

Dataset S1. Profiles of ice surface and bed elevation along a centreline for (a) Belcher, (b) Sydkap, (c) Sverdrup, and (d) Jakeman glaciers. Data downloaded from the National Snow and Ice Datacenter (https://nsidc.org/data/icebridge/data_summaries.html). A close-up view of the terminus region is also shown for Belcher, Sverdrup and Jakeman glaciers. See separate PDF file.

Table S2. Numbers of macronutrient and metal (in parentheses) samples and stations used in data analysis presented in this paper. For the distance categories (<= 1km, 1<x<10 km , >=10 km) only stations along transects from the terminus / shore are used.

Category	**Upper 40 m**	**Below 40 m**	**Stations**
Glacierized	60 (41)	25	31
Non-glacierized	11 (9)	8	6
<= 1km	8 (8)	3 (3)	5
1<x<10 km	24 (18)	16 (15)	11
>=10 km	14 (11)	12 (9)	9
Belcher Glacier	13 (12)	10 (10)	7
Sydkap Glacier	11 (7)	3 (2)	6
Sverdrup Glacier	24 (13)	11 (10)	12
Jakeman Glacier	12 (9)	1 (1)	6
Truelove Bay	6 (6)	3 (3)	3
Grise Fiord	5 (3)	5 (3)	3

Dataset S2. Temperature, Absolute Salinity, potential density anomaly σ_θ, square of the buoyancy frequency N^2, dissolved oxygen concentration, turbidity, photosynthetically active radiation (PAR), and chlorophyll *a* concentration [Chl A], for transects out from the glacier terminus / shore at the four primary glacierized sites (at Belcher, Sydkap, Sverdrup, and Jakeman Glaciers) and two non-glacierized sites (True Love Bay and Grise Fiord) shown on common depth and distance axes. The buoyancy frequency, turbidity, PAR, and [Chl A] are shown on a log scale. See separate PDF file.

Table S3. Summary of bottle data collected and presented in this paper. Highlighted rows represent out transects from four glacierized sites (at Belcher, Sydkap, Sverdrup, and Jakeman Glaciers) and two non-glacierized sites (Truelove Bay and Grise Fiord. Distances are from the glacier terminus for the glacierized sites and from the coast / head of fjord for the unglaciated sites. In Grise Fiord, ~10 km from the head of the fjord there is a constriction, and all distances from shore at this site are given from this constriction point. Uncertainties in the metal concentrations are also shown. See separate PDF file.

Table S4. Statistical summary of comparisons of nutrient concentrations, turbidity, euphotic zone depth, and Chl *a* concentrations in the upper 40-m of the water column at glacierized vs. non-glacierized sites and between individual sample sites (at Belcher, Sydkap, Sverdrup, and Jakeman Glaciers, and at Truelove Bay and Grise Fiord) in Jones Sound. Non-parametric Wilcoxon Rank Sum tests were used to compare the glacierized and non-glacierized sites, while Kruskal-Wallis Rank Sum tests were used to compare the different sites. The Wilcoxon Rank Sum test-statistic, *W*, Kruskal-Wallis chi-squared (χ^2), and p-values are presented. A p-value < 0.05 indicates significant differences for the associated parameter.

Comparison	**[NO_3^-]**	**[PO_4^{3-}]**	**[SiO_4]**	**[NH_4]**	**[Fe]**	**[M]n**	**Turbidity**	**Euphotic Zone Depth**	**[Chl *a*]**
Glacierized & Non-glacierized	W = 538 p = 0.001	W = 490 p = 0.011	W = 534 p = 0.001	W = 447 p = 0.063	W = 321 p = 0.0002	W = 282.5 p = 0.014	W = 236455 $p < 2.2 \times 10^{-16}$	W = 44042 $p < 2.2 \times 10^{-16}$	W = 154462 p = 0.3793
Individual Sites	$\chi^2 = 28.0$ $p = 3.7 \times 10^{-5}$	$\chi^2 = 14.4$ p = 0.01	$\chi^2 = 27.2$ $p = 5.1 \times 10^{-5}$	$\chi^2 = 14.2$ p = 0.01	$\chi^2 = 23.0$ p = 0.0003	$\chi^2 = 13.2$ p = 0.02	$\chi^2 = 472.8$ $p < 2.2 \times 10^{-16}$	$\chi^2 = 645.3$ $p < 2.2 \times 10^{-16}$	$\chi^2 = 571.3$ $p < 2.2 \times 10^{-16}$

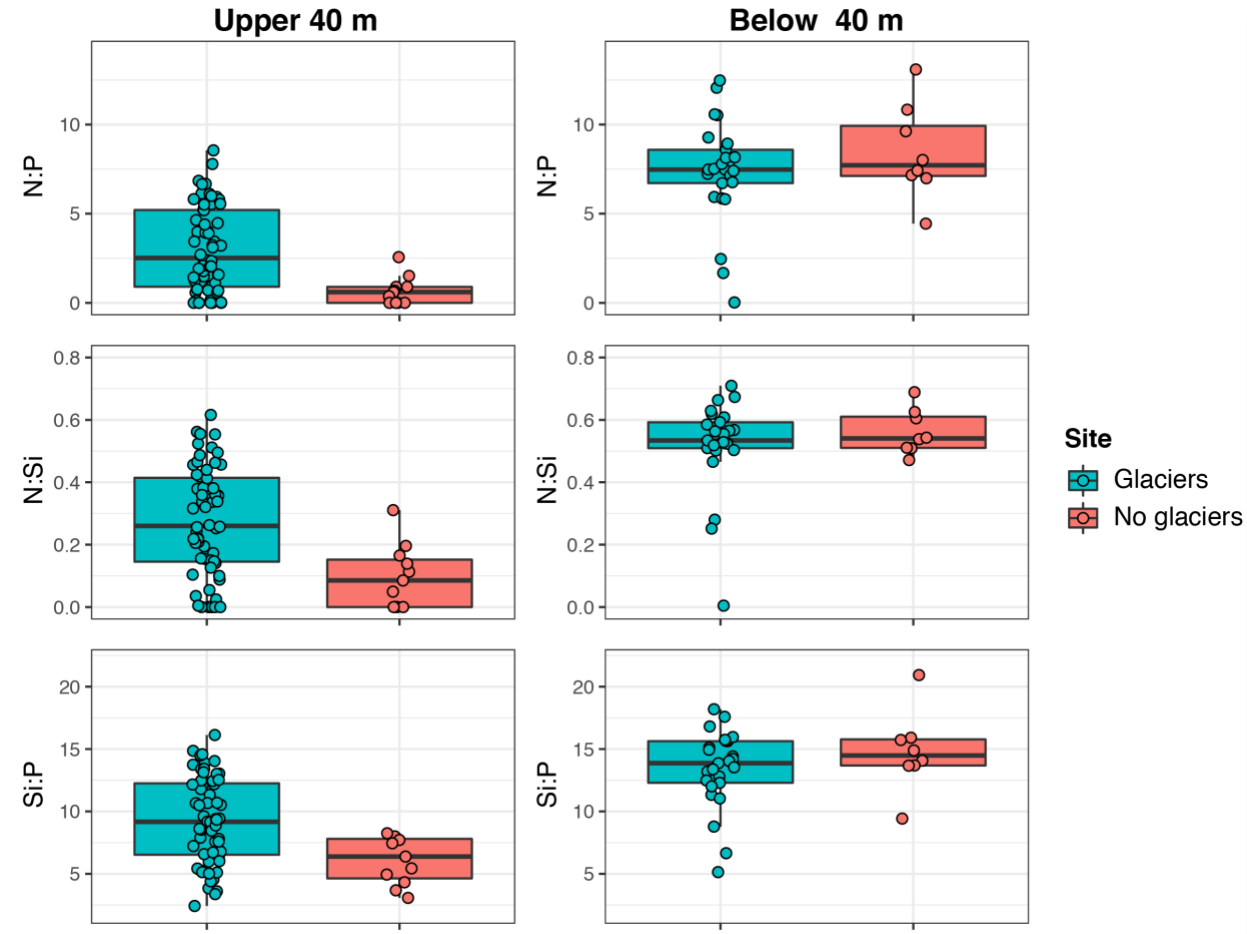

Figure S1. Comparisons of major nutrient ratios in surface (upper 40-m) and deep (lower 40-m) ocean waters at glacierized sites (at Belcher, Sydkap, Sverdrup, and Jakeman Glaciers) and non-glacierized sites (True Love Bay and Grise Fiord). The individual data points are shown for the surface (n = 60, glacierized and n = 11, non-glacierized) and deep (n = 25, glacierized and n = 8, non-glacierized) waters. The marine ecosystem in Jones Sound is likely nitrate-limited, since the surface N:P ratio is less than the Redfield ratio (16:1). However, surface waters in glacierized regions are closer to deep water nutrient ratios than surface waters in non-glacierized regions.

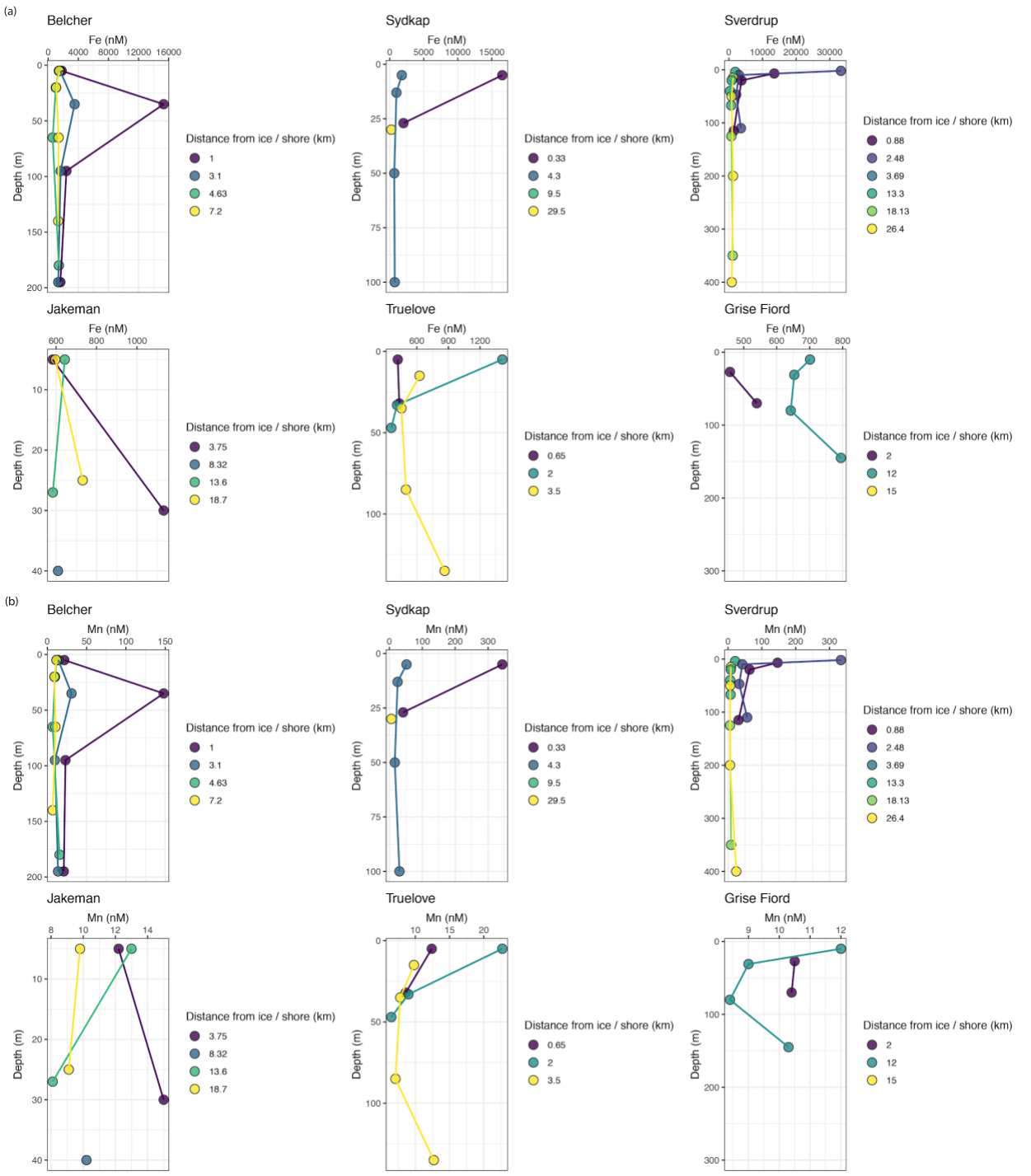

Figure S2. Water column profiles of (a) total dissolvable iron (TdFe) and (b) total dissolvable manganese (TdMn) along marine transects, with distance from the glacier terminus / shore shown by color.