

Lability of land- and sediment-derived dissolved organic carbon in high Arctic fjords (Spitsbergen)

Katarzyna Koziorowska-Makuch, Fernando Aguado Gonzalo, Laura Bromboszcz, Magdalena Diak, Przemysław Makuch, Izabela Pałka, Marcin Stokowski, Beata Szymczycha, Aleksandra Winogradow, Kuliński Karol

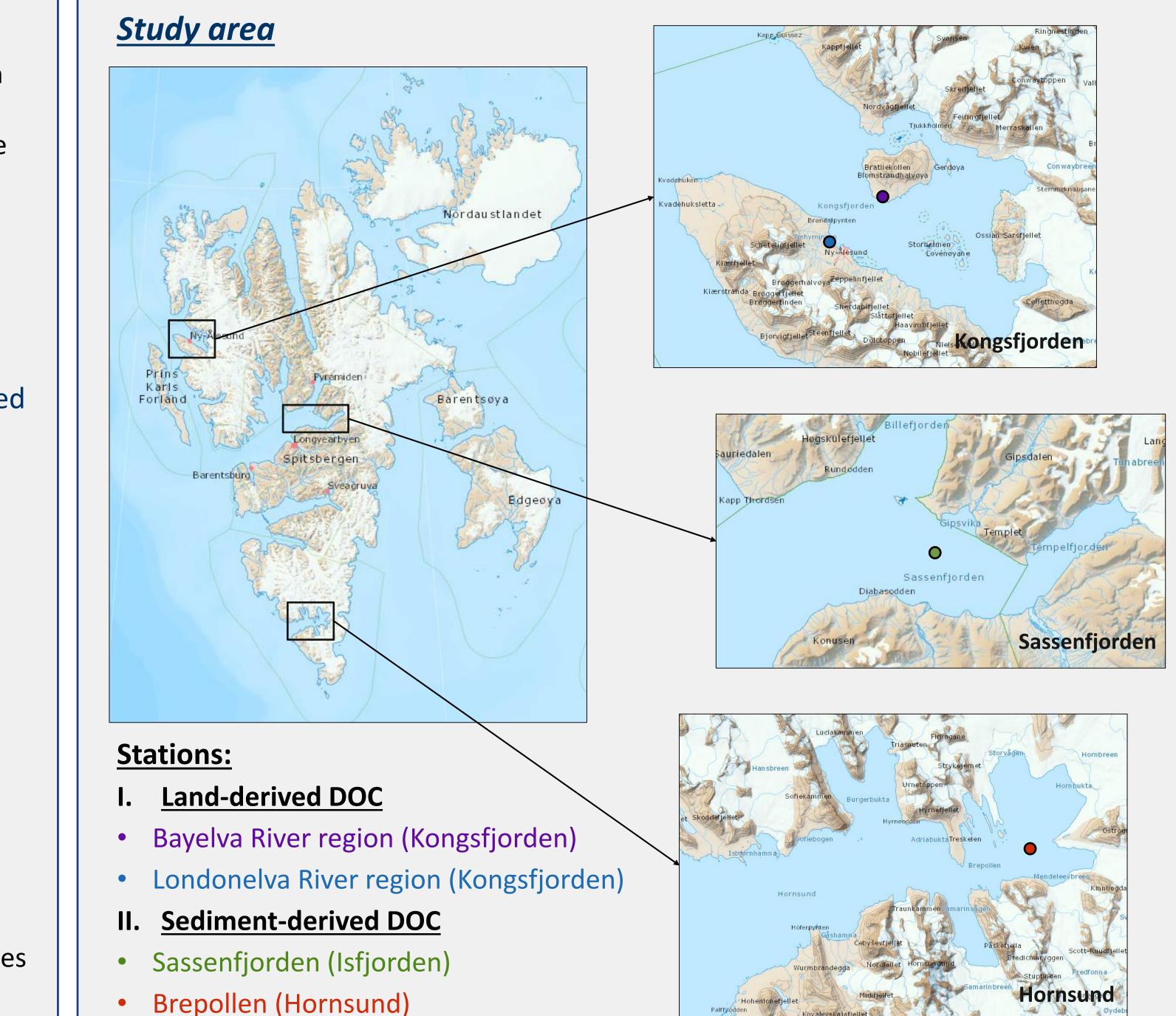
Institute of Oceanology Polish Academy of Sciences, Sopot, Poland *kkozio@iopan.pl

Introduction

Dissolved organic carbon (DOC) is the largest organic carbon pool in the ocean. While in the open waters this pool is relatively constant, it continuously evolves in the coastal zone with the most prominent changes occurring in the Arctic. Although there are some quantitative estimations of different DOC loads to the Arctic fjords, their fate remains highly unknown. It is still unclear to what extent the DOC entering the fjords is bioavailable and how fast can it be remineralised.

Research objectives

- to quantify the share of labile (DOC_1), semi-labile (DOC_{S1}), and refractory (DOC_R) fractions in the terrigenous and sediment-derived DOC,



Abstract

Number

5648

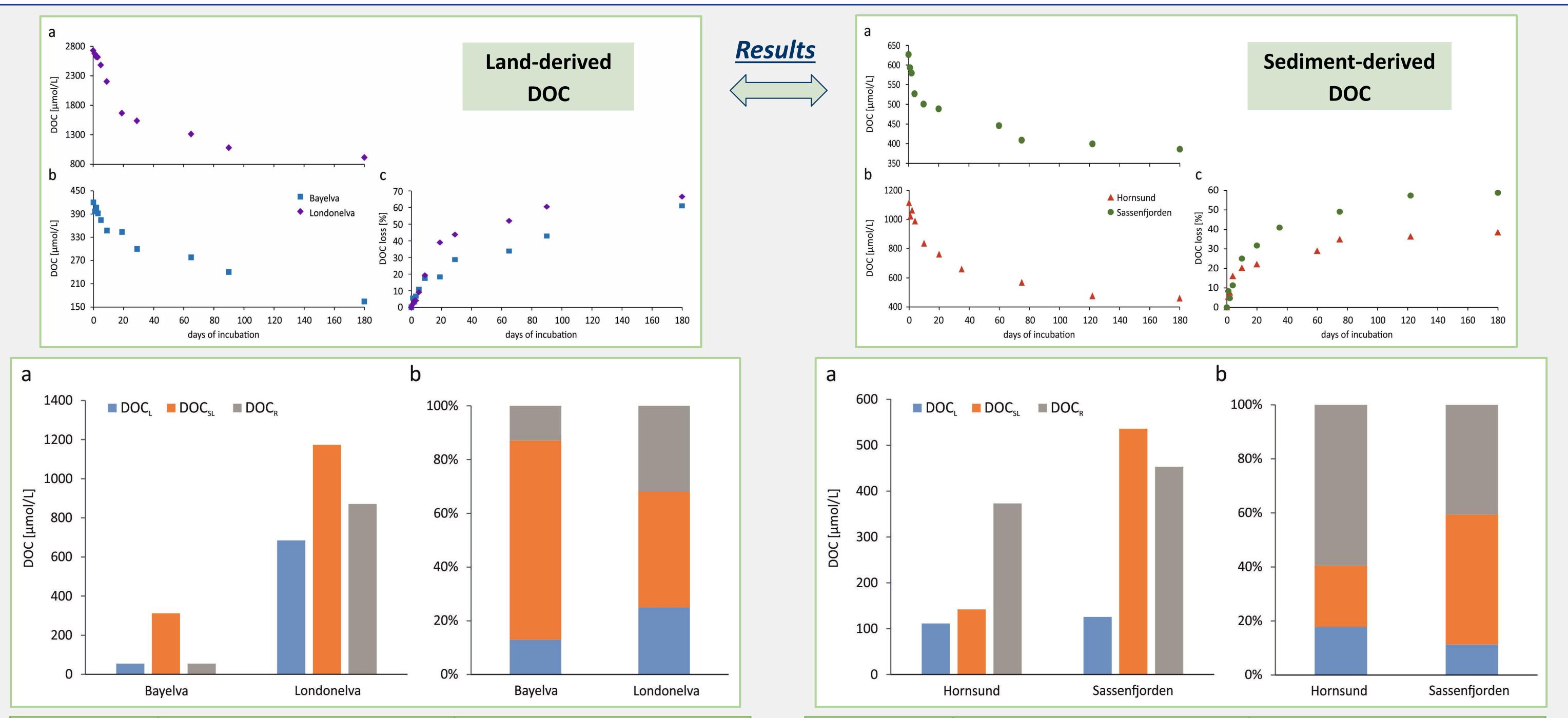


ion

to estimate remineralization rate constants (k) and half-life times $(t_{1/2})$ for bioavailable fractions of DOC.

time $DOC_{(t)} = DOC_{L(t=0)} \cdot e^{-k_{(L)} \cdot t} + DOC_{SL(t=0)} \cdot e^{-k_{(SL)} \cdot t} + DOC_{R}$

This has been done through the 180-days-lasting incubation experiments of soil leachates mixed with surface seawater and sediment interstitial waters mixed with bottom water.



DOC fraction	Вау	elva	Londonelva			
	k [days⁻¹]	t _{1/2} [days]	k [days⁻¹]	t _{1/2} [days]		
DOCL	0.115-0.029	6-24	0.046-0.012	15-60		

Horn	sund	Sassenfjorden			
k [days ⁻¹]	k [days ⁻¹] t _{1/2} [days]		t _{1/2} [days]		
0.440	1.6	0.157	4.4		
	k [days ⁻¹]		k [days ⁻¹] t _{1/2} [days] k [days ⁻¹]		

DOC _{SL}	0.003-0.001	206-822	0.011-0.003	65-260	DOC _{SL}	0.014	49.9	0.025	28.1	

Conclusions

- the soil leachates and interstitial waters contain a lot of DOC (420-2730 μmol L⁻¹ and 220-470 μmol L⁻¹, respectively), which is highly bioavailable even 68-87% and 40-59% can be susceptible to biodegradation, respectively,
- contribution of the most labile DOC fraction is small and ranges from 13% to 25% for the soil leachates and from 11% to 18% for interstitial waters, but it remineralizes quickly within days or weeks, while the semi-labile DOC, whose half-life is measured in months, is much more abundant,
- determined remineralization rate constants for both the labile and semi-labile fractions of DOC may be directly applicable in biogeochemical models used in the Spitsbergen region,
- high lability of DOC indicates that its supply to the fjords water column has the potential to play an essential role in sustaining the bacterial loop in the fjord and, through CO₂ release, in amplifying ocean acidification in the coastal zone.

Acknowledgements: This study was financially supported by the National Science Centre, Poland (2019/34/E/ST10/00167), the Norwegian Financial Mechanism 2014–2021 (2019/34/H/ST10/00645 and 2019/34/H/ST10/00504), and the statutory activities of the Institute of Oceanology Polish Academy of Sciences. KKM acknowledges the scholarship in the frame of Bekker Programme (PPN/BEK/2019/1/00070) funded by the Polish National Agency for Academic Exchange.



