Tracing Three Decades of Anthropogenic Carbon in the Canada Basin Using Nuclear Waste Products

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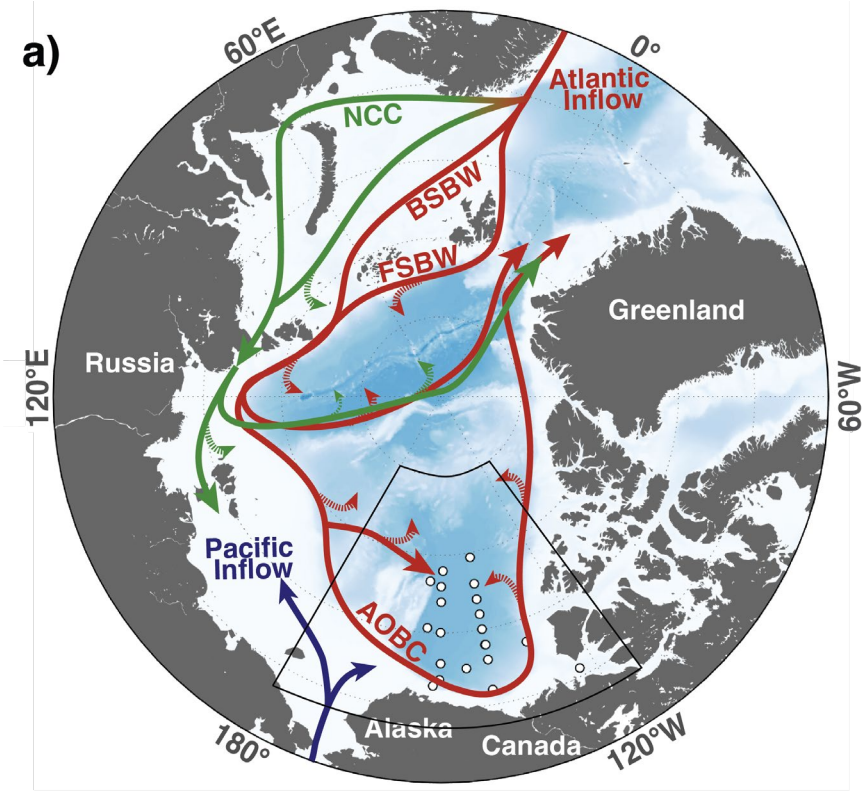
Motivation:



1. The oceans absorb approximately **25 - 30 %** of **anthropogenic carbon** emissions *(Gruber et al. 2023).*

2. The Arctic Ocean stores **2 – 3 %** of the global inventory of anthropogenic carbon *(Tanhua et al. 2009).*

3. In and around the **Canada Basin**, aragonite undersaturation is already observed *(e.g. Yamamoto-Kawai et al. 2009, 2025).*

The ^{129}I-^{236}U Tracer Pair

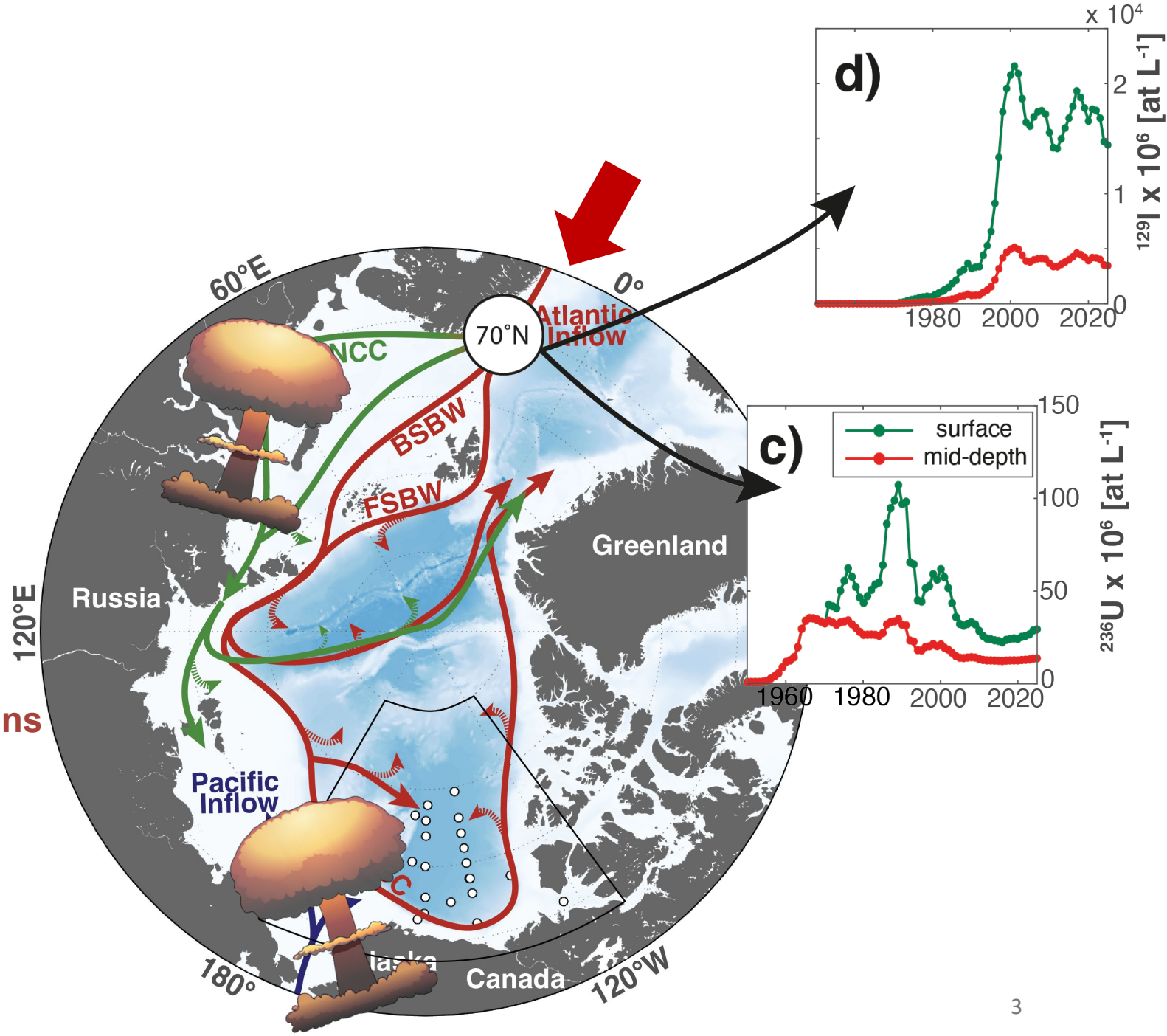
First released by nuclear weapons testing in the 50s/60s.

Low-level global signal found in all oceans.

From the 70s Nuclear waste released annually from reprocessing facilities in Europe into the Atlantic.

High, nuclear reprocessing concentrations label Atlantic Water

Low, global fallout concentrations label Pacific Water



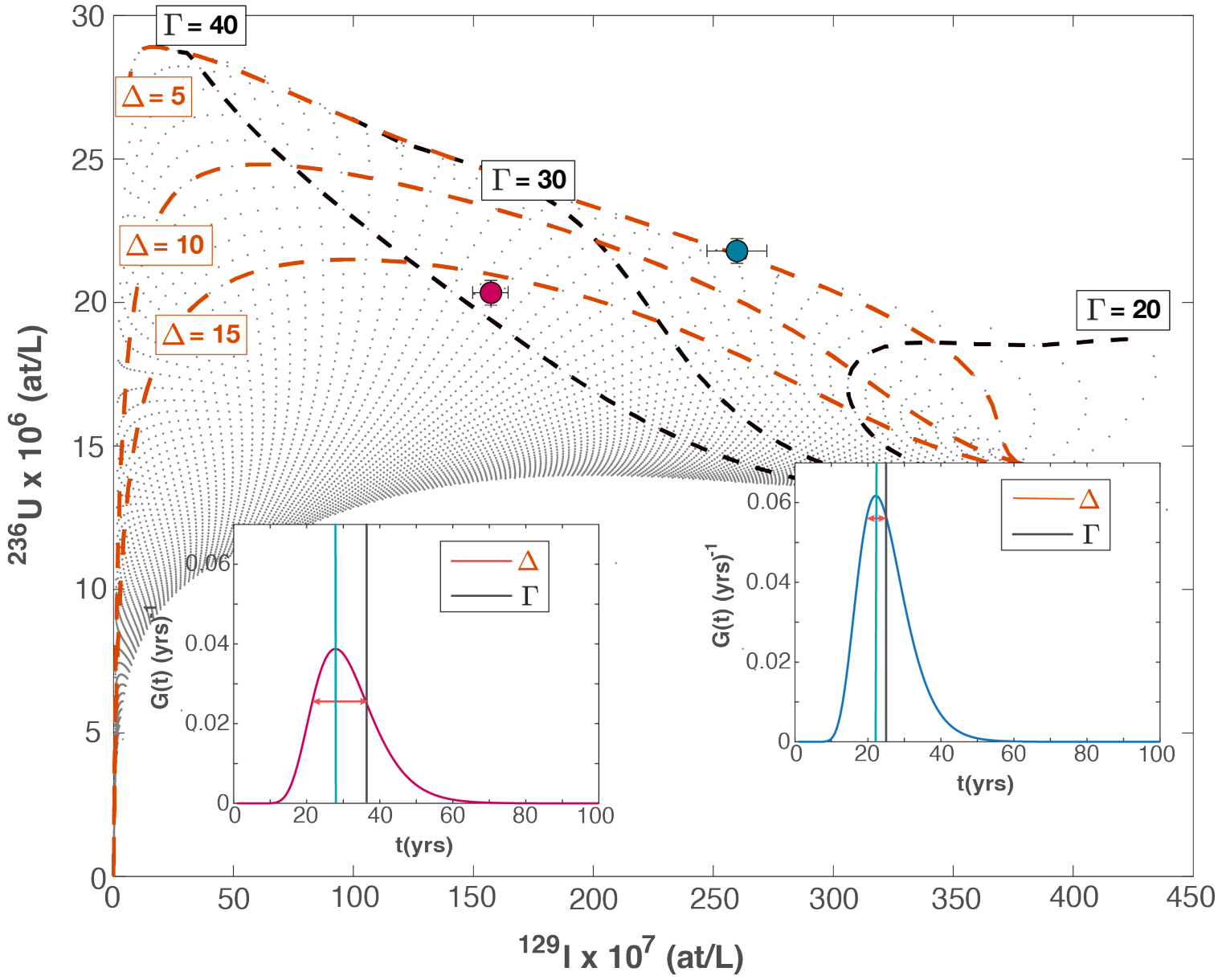
T_{mode} = Most likely Age

Δ = How much mixing

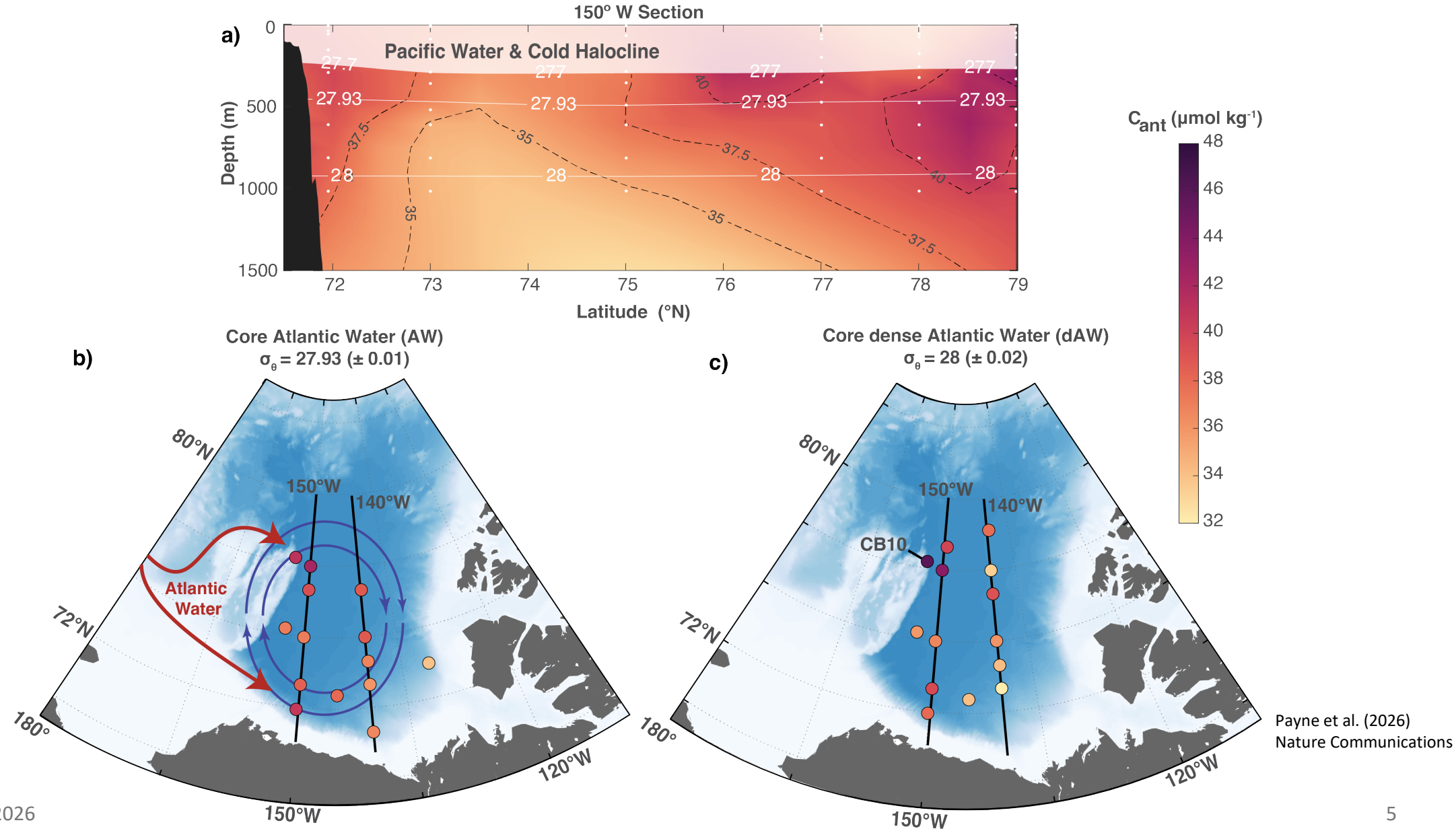
Γ = Mean transport time

Another TTD

Estimate Anthropogenic Carbon

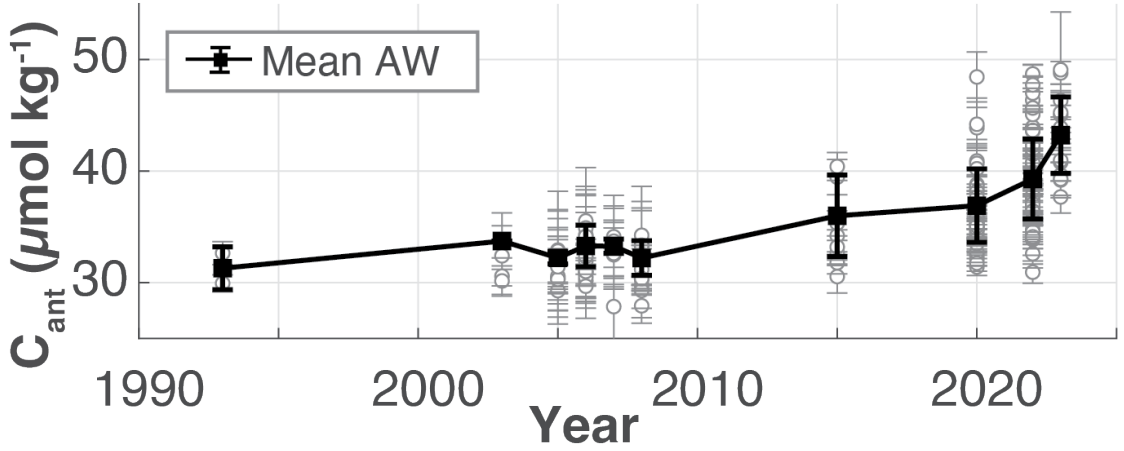


Distribution of C_{ant} in 2022:



Payne et al. (2026)
Nature Communications

C_{ant} content in Atlantic Water through time:



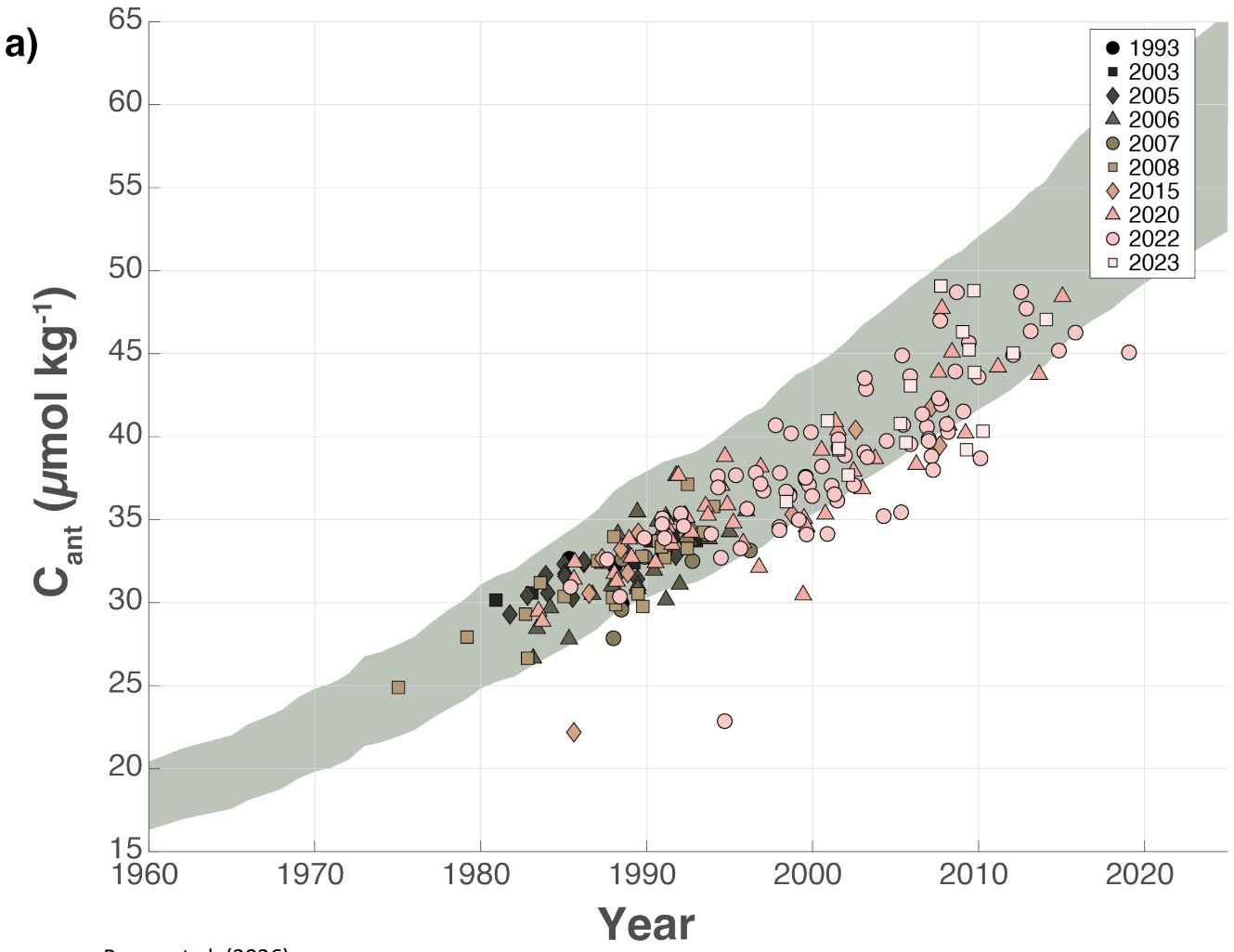
Payne et al. (2026)
Nature Communications

Increase in core boundary current of 0.76 umol/kg/yr (2003-2023)

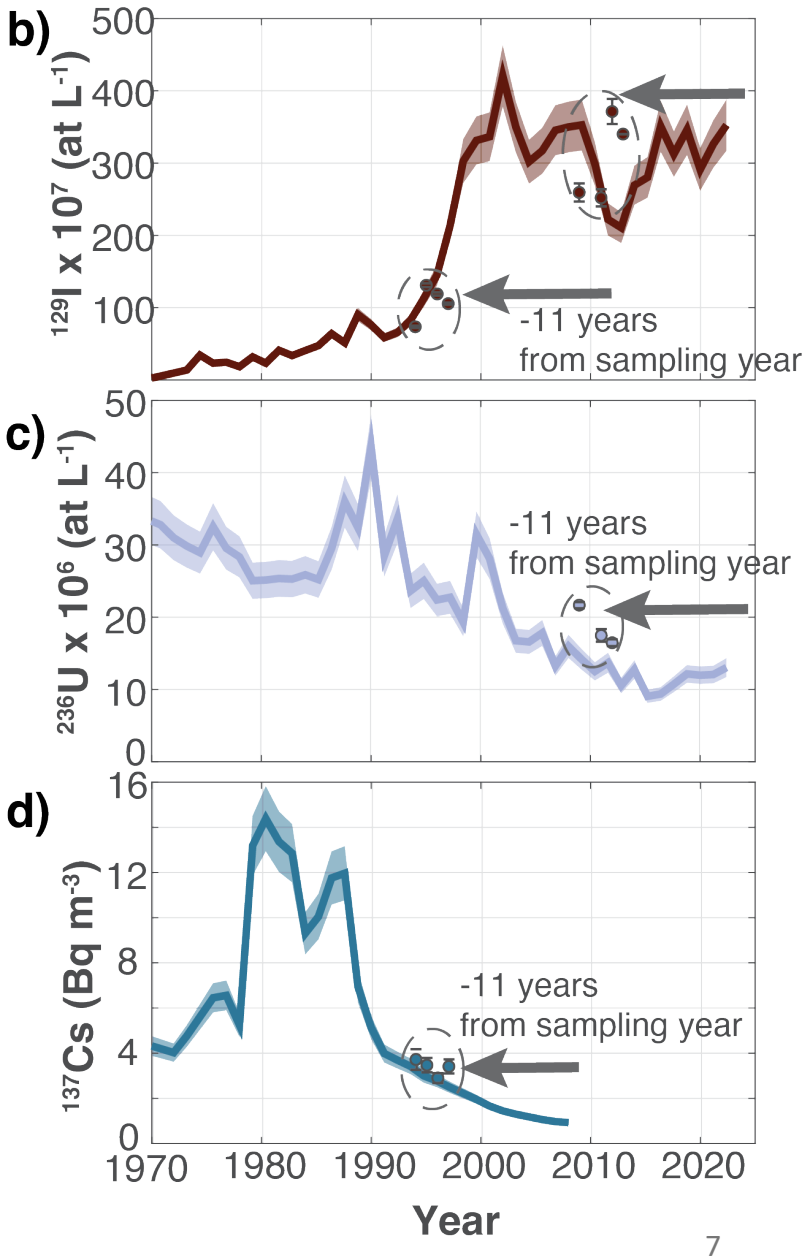
Rate of basin inventory increase:
(<u>only</u> the Atlantic layer, 400 -1000 m, 2003 - 2023)

5.5 ± 0.9 Tg C yr^{-1}

Estimating future C_{ant} in the Canada Basin:



Payne et al. (2026)
Nature Communications



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[3] Yamamoto-Kawai, M., McLaughlin, F.A., Carmack, E.C., Nishino, S. and Shimada, K., 2009. Aragonite undersaturation in the Arctic Ocean: effects of ocean acidification and sea ice melt. Science, 326(5956), pp.1098-1100.

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