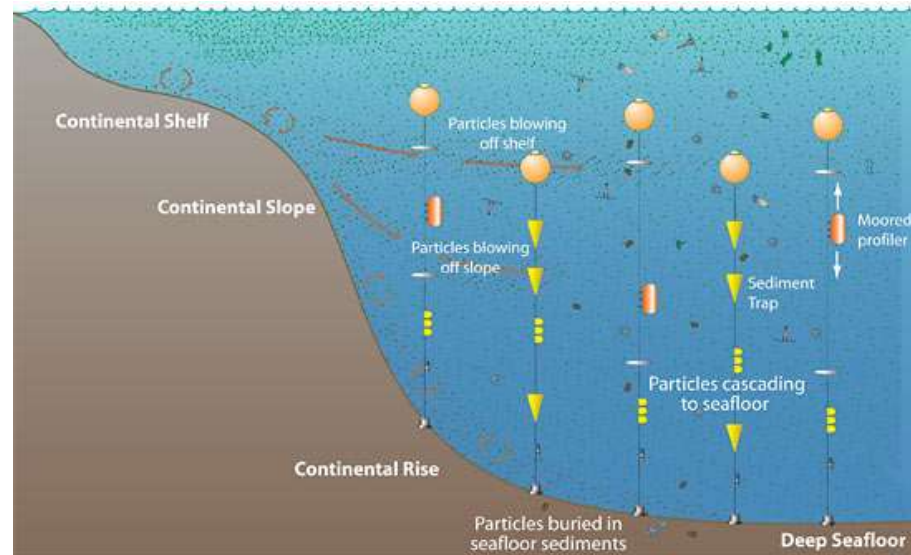


# Lateral particle supply as a key vector in the oceanic carbon cycle



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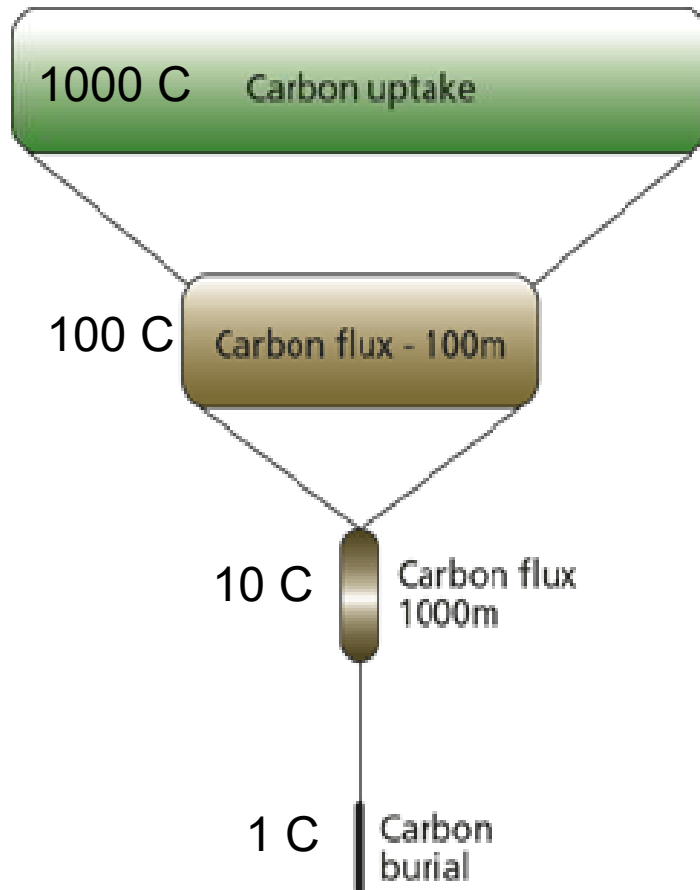
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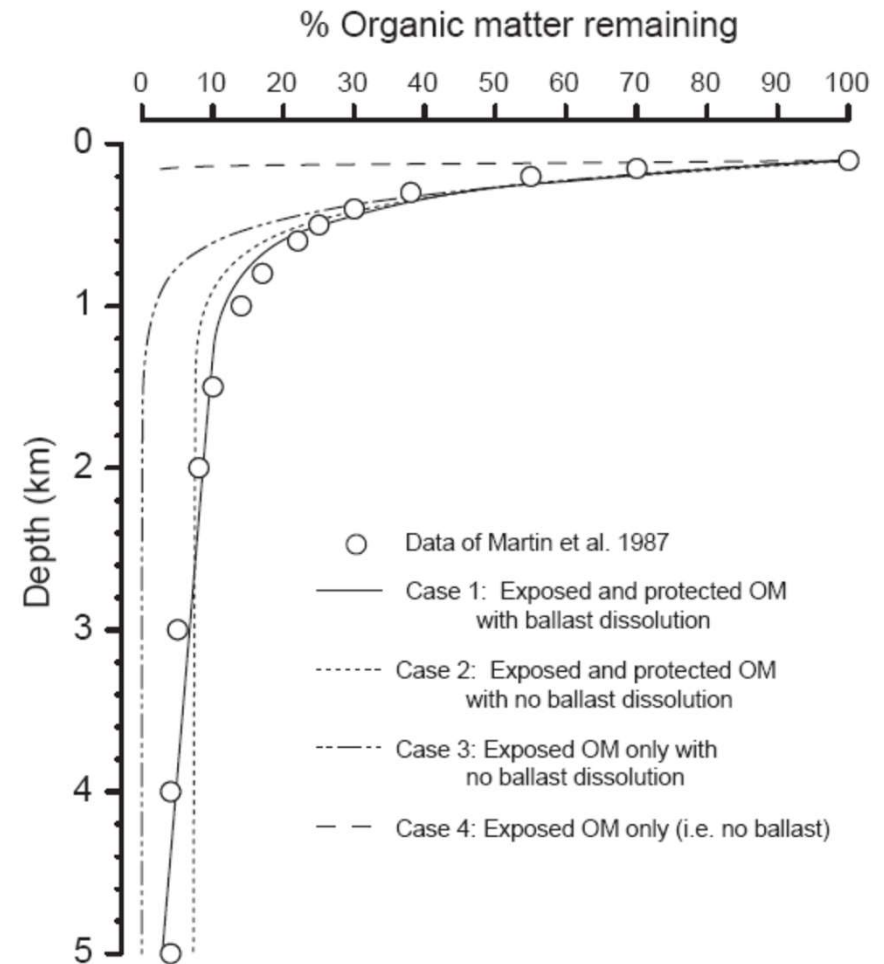
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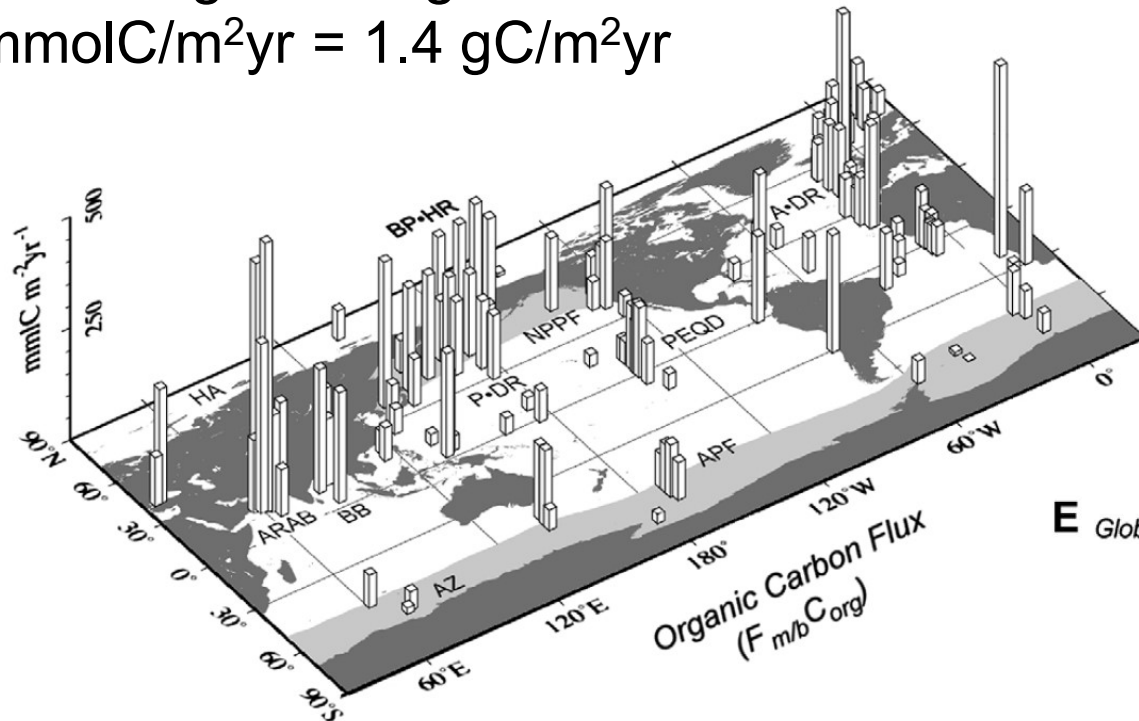
- POC export and vertical transport
- Content and flux of lithogenic material in sinking particles
- Radiocarbon of sinking POC



(JGOFS)



Global average sinking POC flux at 2000m  
 $120 \text{ mmolC/m}^2\text{yr} = 1.4 \text{ gC/m}^2\text{yr}$

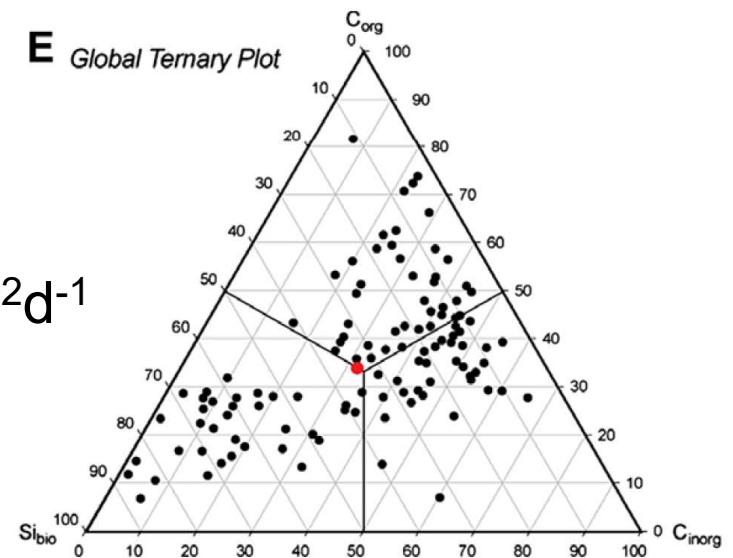


Biogenic material flux at 2000 m =  $60 \text{ mg m}^{-2} \text{d}^{-1}$

Organic matter = 8

$\text{CaCO}_3$  = 31

Opal = 21

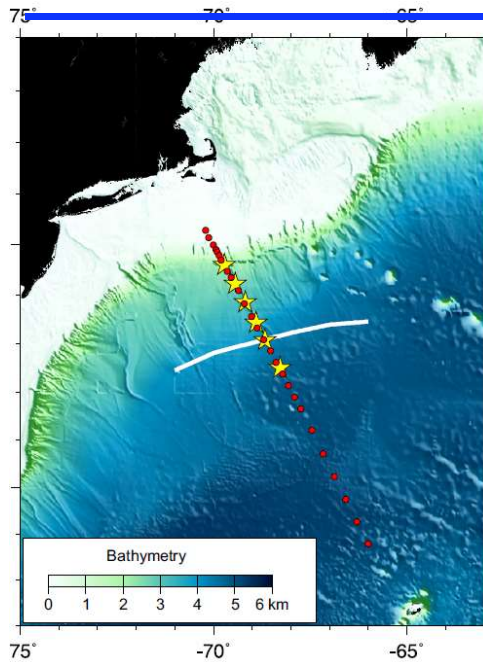


**Not mention about non-biogenic particles!**

(Honjo et al., 2008)

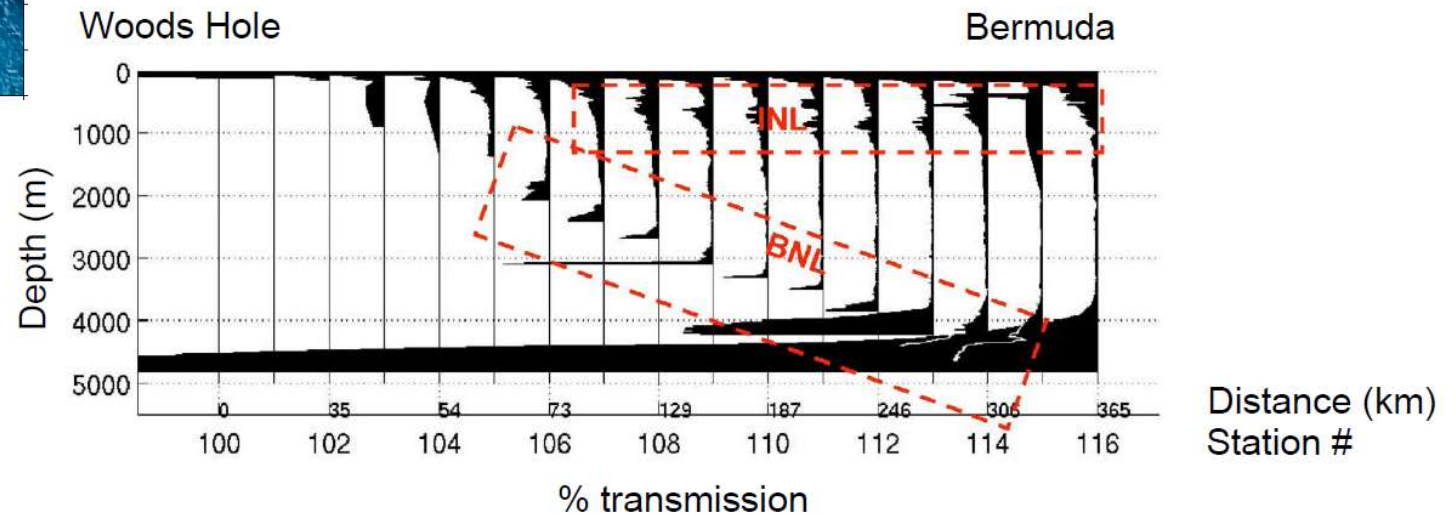
## Particle flux from below of from sides

May 06, 2020



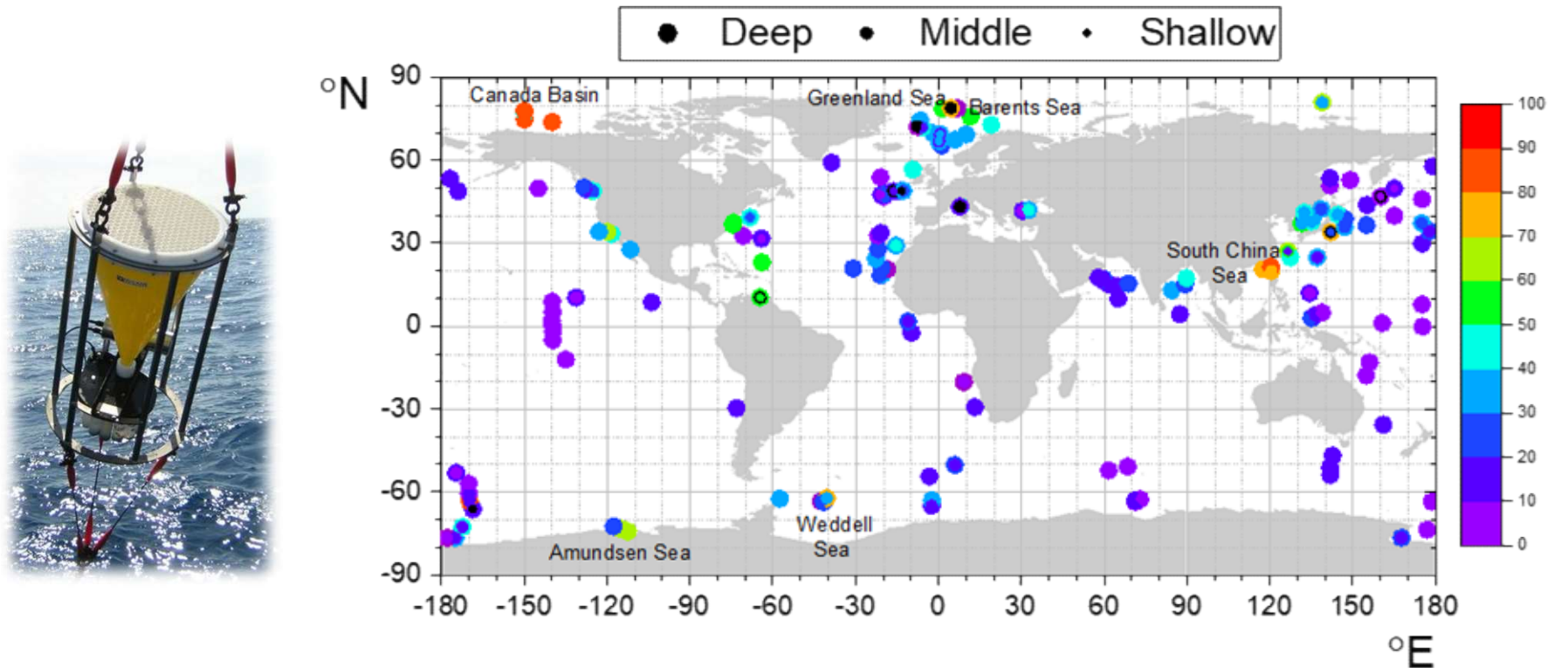
### BNL (Bottom Nepheloid Layers)

- : layers of high particle concentration near the seafloor
- : formed by injection of particles from the shelf break and relatively shallow part of the slope



(borrowed from van der Loeff and Kretschmer's presentation)

John Toole in  
GEOTRACES Atlantic Report



(Kim et al., submitted)

## How about particle flux from below of from sides?

Content and flux of lithogenic material in sinking particles

Total 154 sites examined

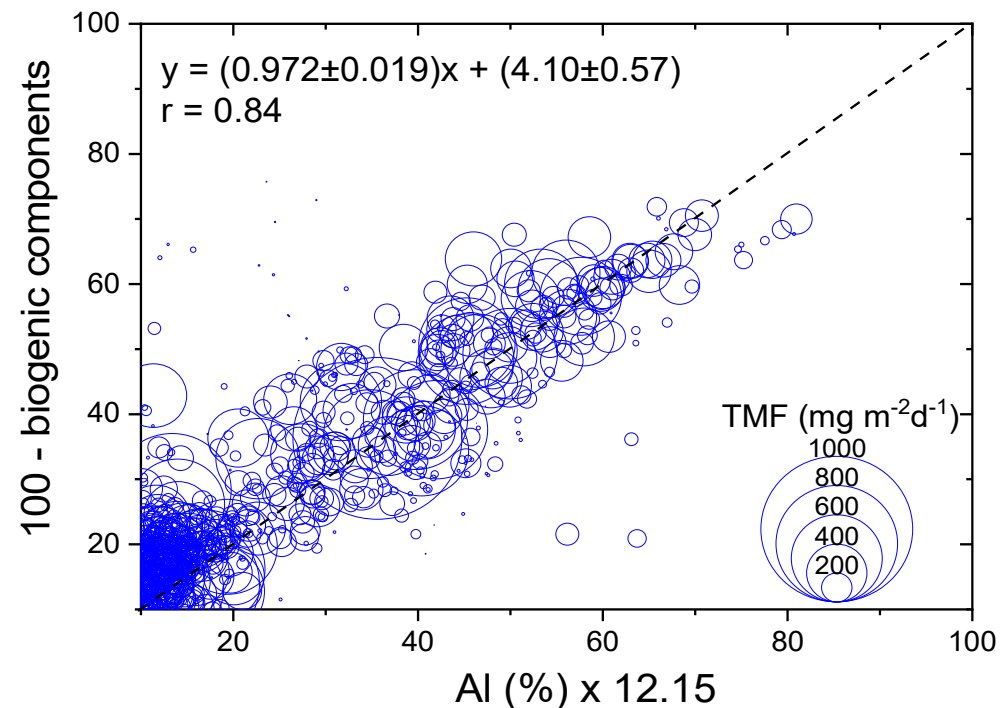


### Data

- JGOFS: [http://usjgofs.whoi.edu/mzweb/data/Honjo/sed\\_traps.html](http://usjgofs.whoi.edu/mzweb/data/Honjo/sed_traps.html); data compiled by S. Honjo, R. Francois, and S. J. Manganini
- PANGAEA: <https://www.pangaea.de/>
- Other literature data

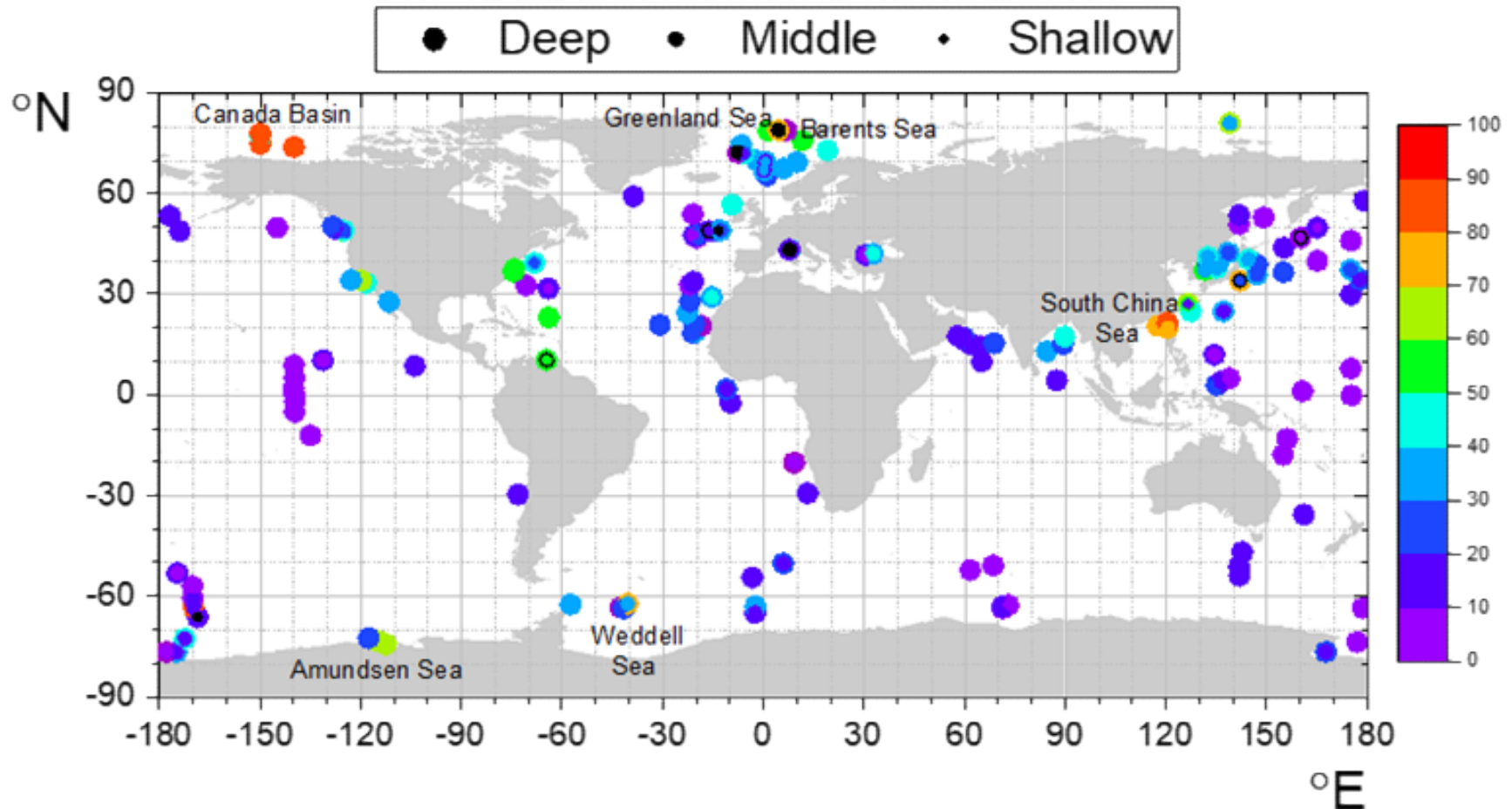
### Lithogenic material

- 1) Reported as lithogenic material by authors
- 2) Total mass – biogenic material (=  $\text{POC} \times 1.88 + \text{opal} + \text{CaCO}_3$ )
- 3) Aluminum  $\times 12.15$



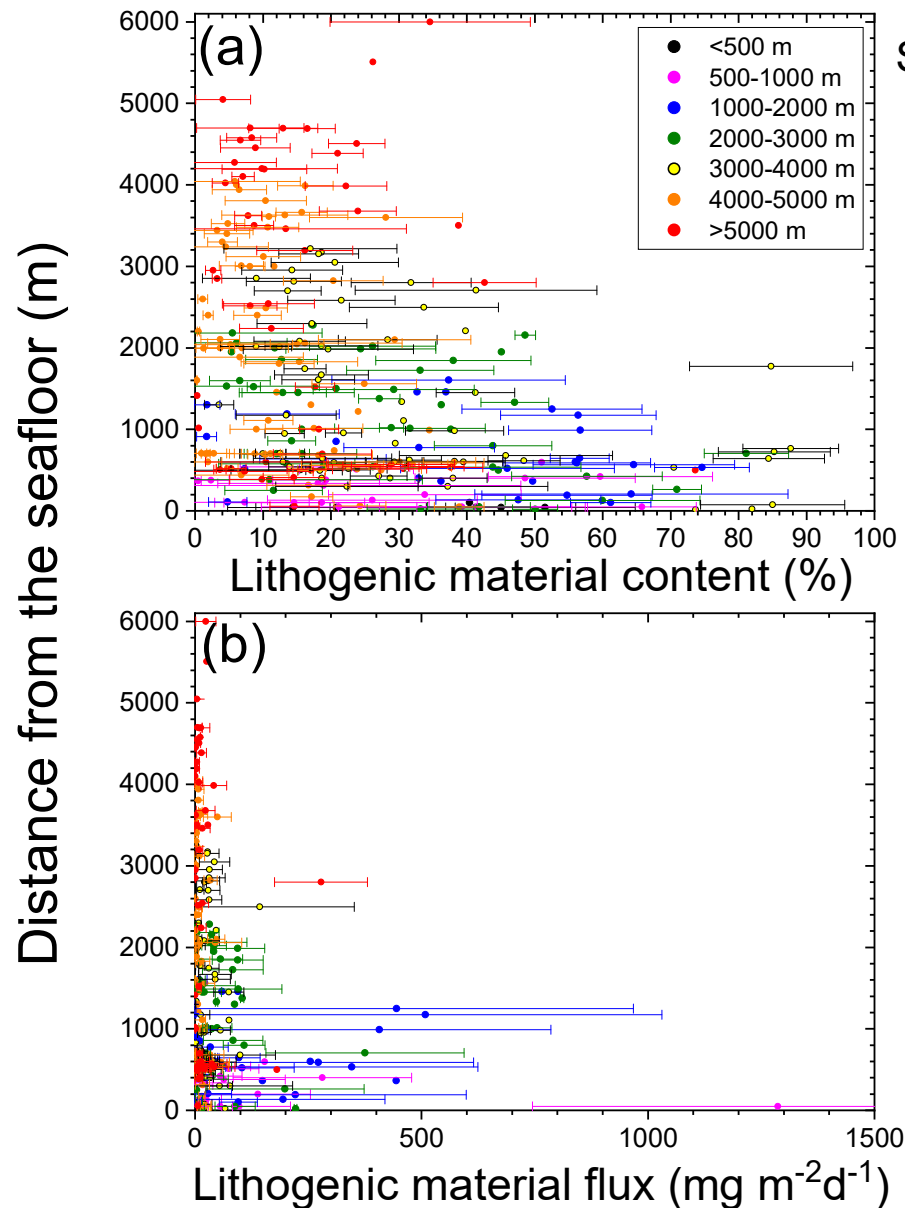
(Kim et al., submitted)

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- Continental shelf (<500m):  $32 \pm 20$  % (Kim et al., submitted)
- Continental slope (500-3000m):  $34 \pm 23$  %
- Abyssal plane (>3000m):  $19 \pm 21$  %



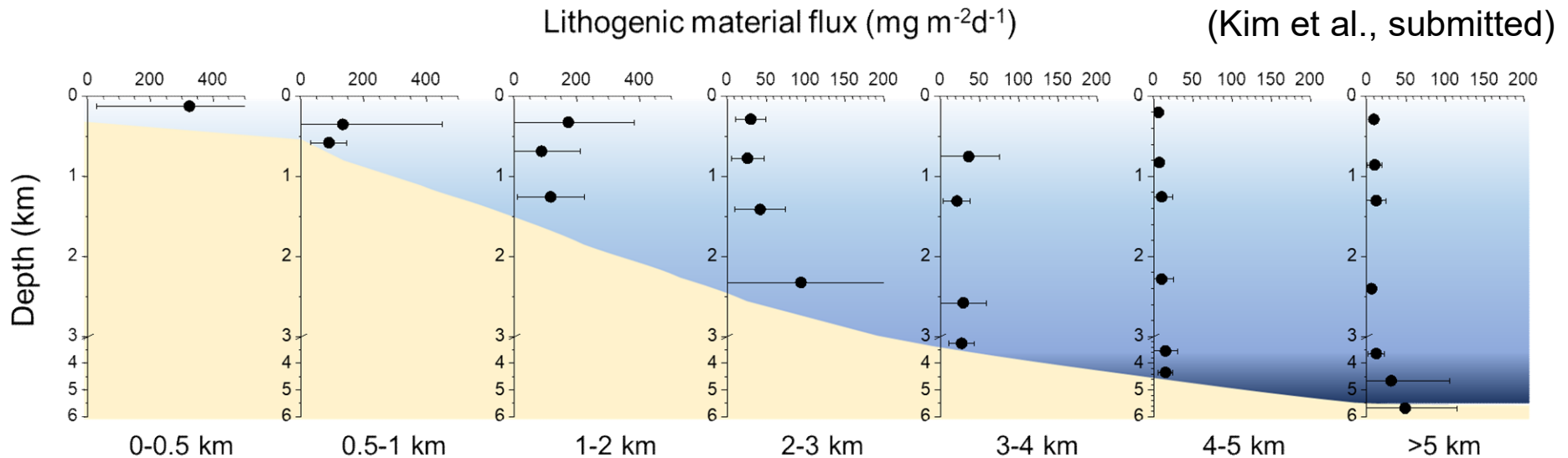


Symbol color: water depth (m)

- Lithogenic material content and flux are higher at deeper depths
- Sediment resuspension is the major source

(Kim et al., submitted)

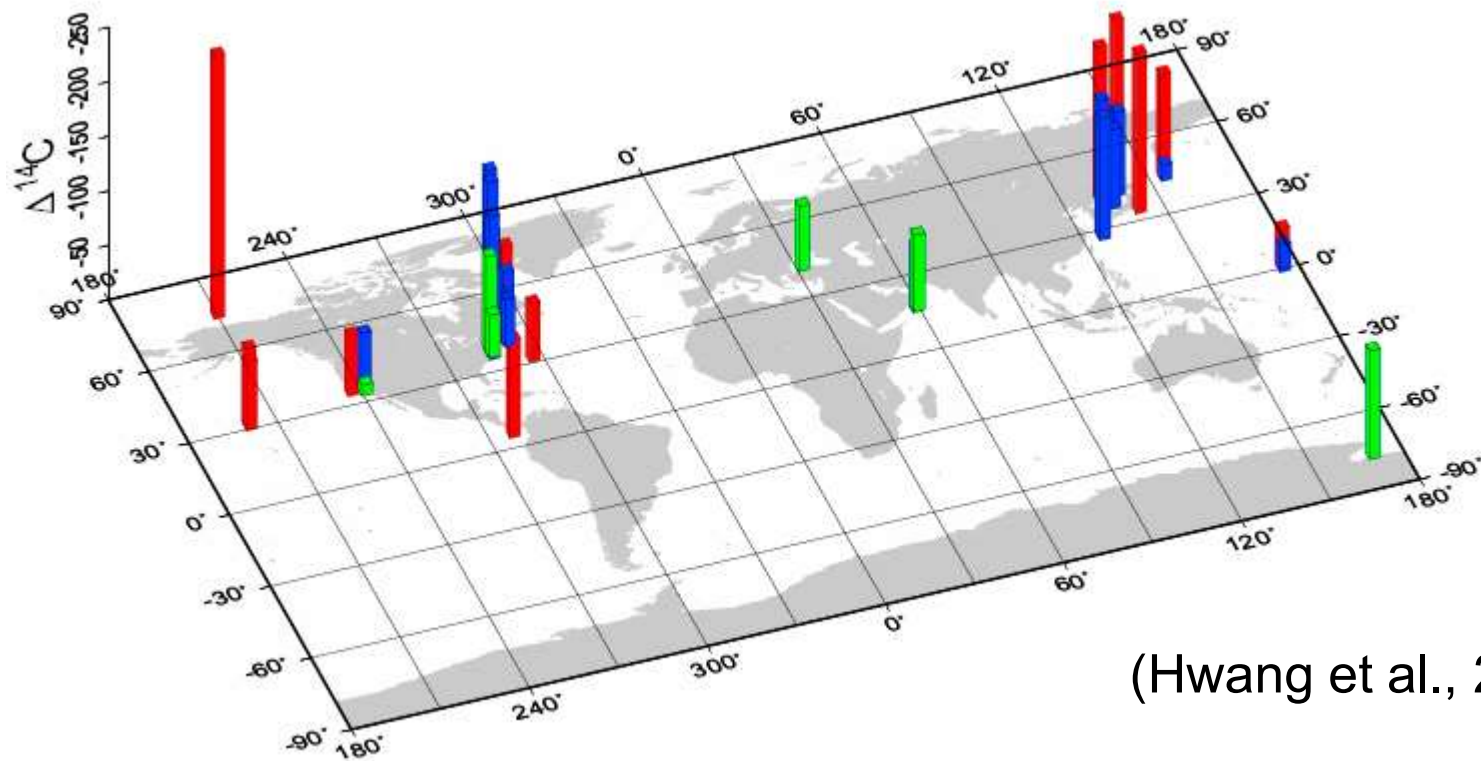
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- **0.5-1 km** (water depth): Lithogenic material flux was higher at the shallower depths than that near the seafloor
- **1-2 km**: Clear water layer between the surface and near the seafloor
- **2-3 km**: Local sediment resuspension and/or lateral transport along the slope appeared more important than the particles emanating from the shelf break
- **>3 km**: vertical distribution was uniform  
No significant elevation in particle flux near the seafloor

Overall lithogenic material fluxes diminishing with increasing distance from the coast

- Lower than the freshly produced POC in the surface water
- Existence of aged organic carbon



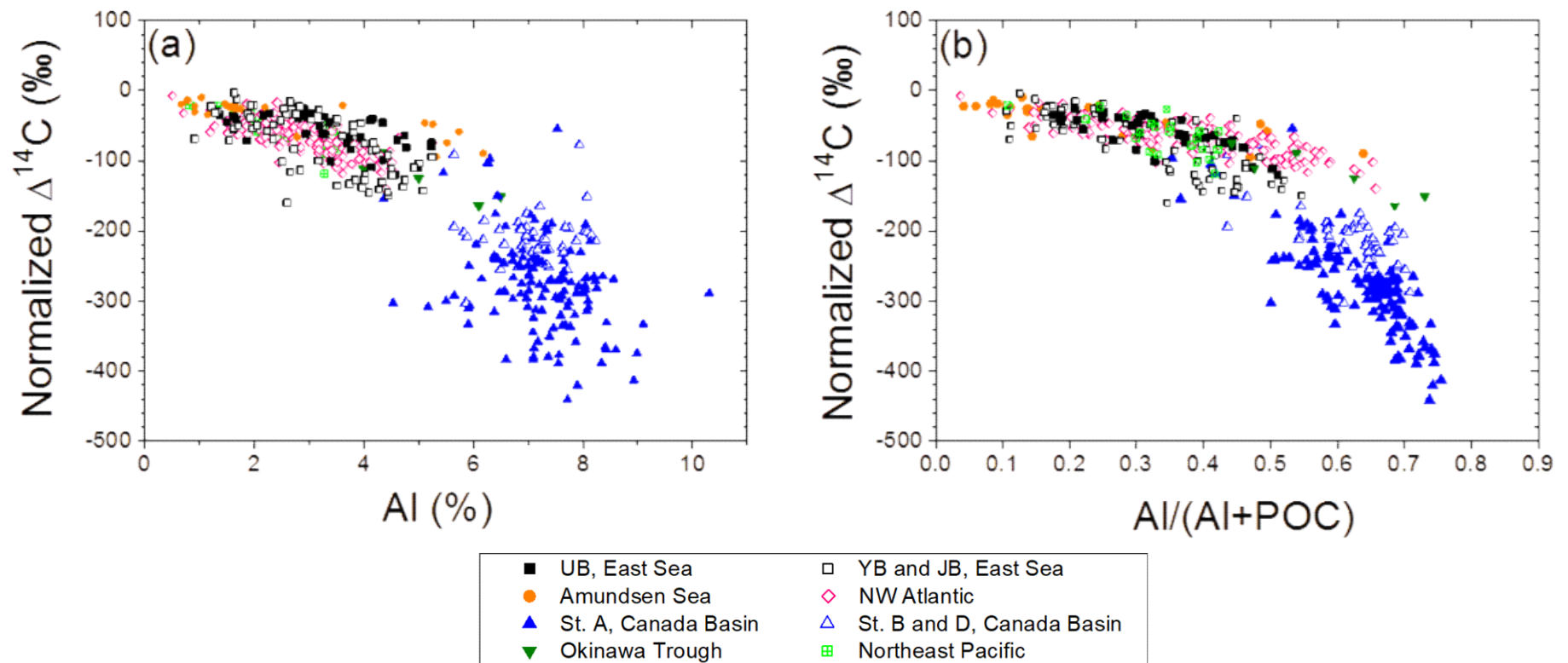
(Hwang et al., 2010)

$\Delta^{14}\text{C}$

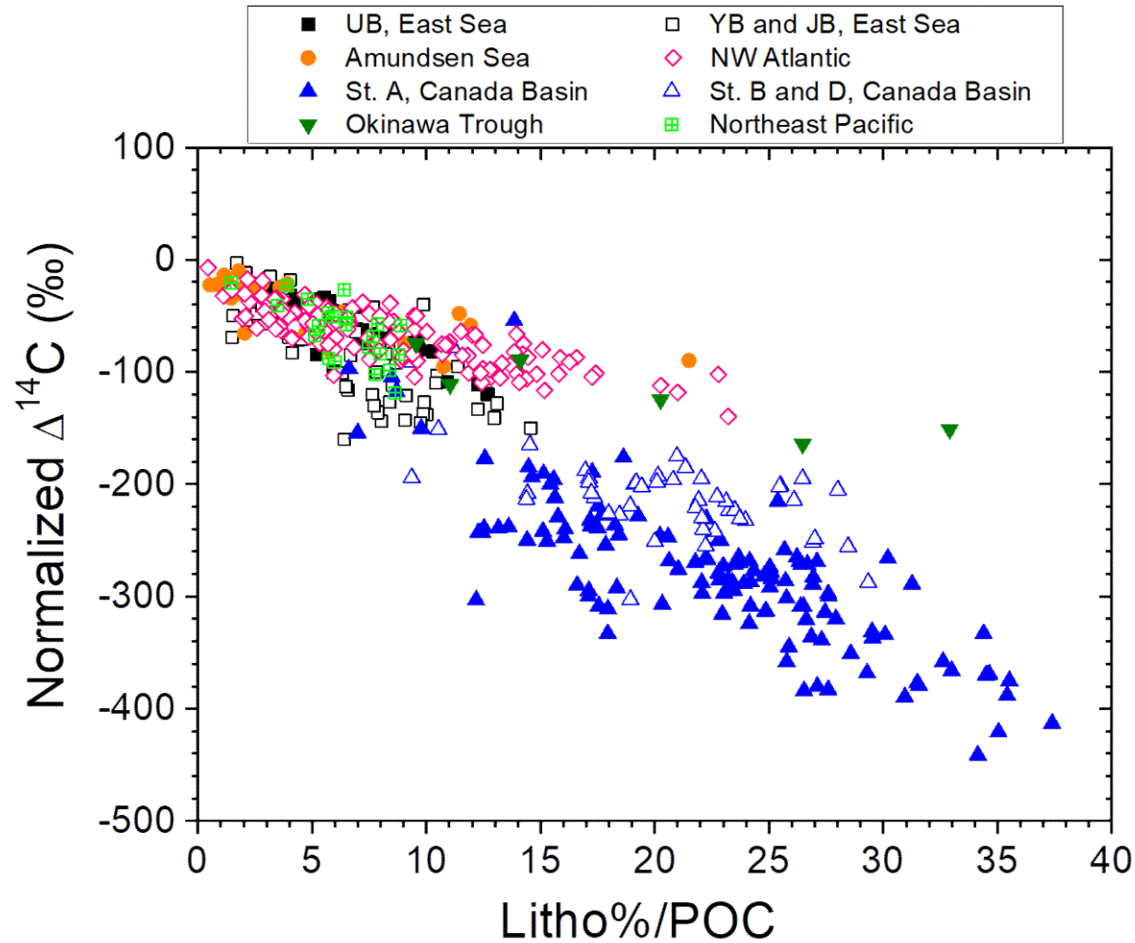
- Modern organic matter =  $\sim 0 \text{ ‰}$
- Aged for one half-life (5730 years) =  $\sim -500 \text{ ‰}$
- $^{14}\text{C}$ -free fossil fuel =  $-1000 \text{ ‰}$

## Aluminum

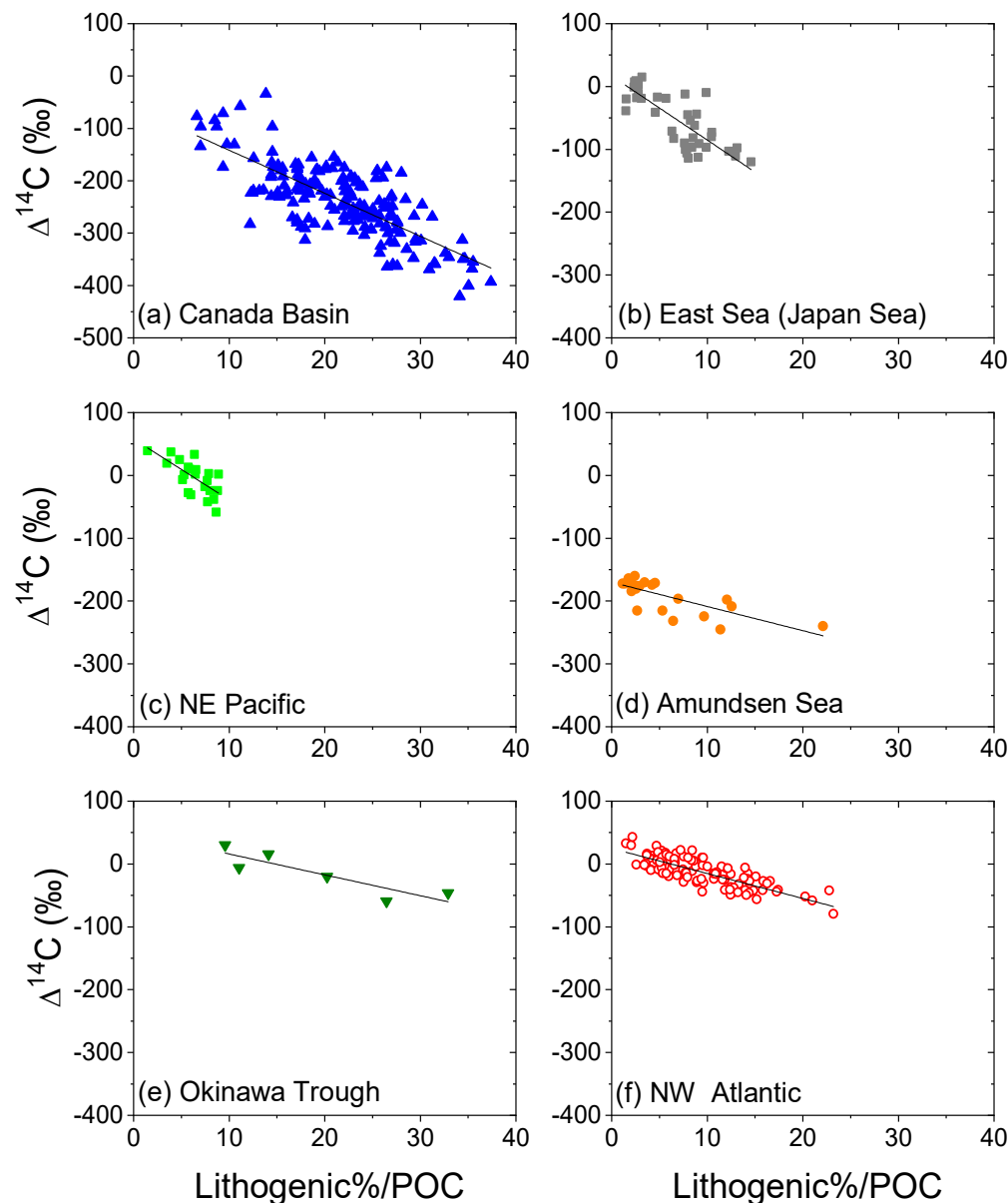
- Major constituent of lithogenic material (aluminosilicate minerals)
- Proxy for resuspended sediment particles



$$\text{Al (\%)} = \text{Al} / (\text{Al} \times 12.15 + \text{POM} + \text{CaCO}_3 + \text{opal}) \times 100$$



$$\text{Slope} = \Delta^{14}\text{C}_{\text{suspended particles}} \times \alpha$$
$$\alpha = (\text{POC}_{\text{suspended}} / \text{lithogenic material})$$



- Similarity in  $\alpha$  (%) and in surface sediments: most of OC in sediments exists as associated with lithogenic material
- Particulate organic carbon from sediment resuspension accounts for 0.2-0.3 % of sinking particles, and 3-5 % of sinking POC

	slope	Norm. $D^{14}C_{res}$	$\alpha$ (%)	OC% of surface sediment
Canada Basin	-8.2	-720	1.2	1.3
East Sea	-10.2	-375	2.6	1.0
Northeast Pacific	-9.7	-266	3.0	1.4
Amundsen Sea	-3.9	-418	1.6	1.0
Okinawa Trough	-3.3	-300	1.0	1.0±0.5
Northwest Atlantic	-4.0	-260	1.4	0.8±0.2

(Kim et al., submitted) 14



- Mean flux of lithogenic material accounts for **25±20 %** of sinking particles globally.
- Lithogenic material content and flux decreases with increasing distance from the seafloor and the coast.
- Particulate organic carbon from sediment resuspension accounts for **0.2-0.3 %** of sinking particles, and **3-5 %** of sinking POC.

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