In Search Of The Radiocarbon Distribution In DOC

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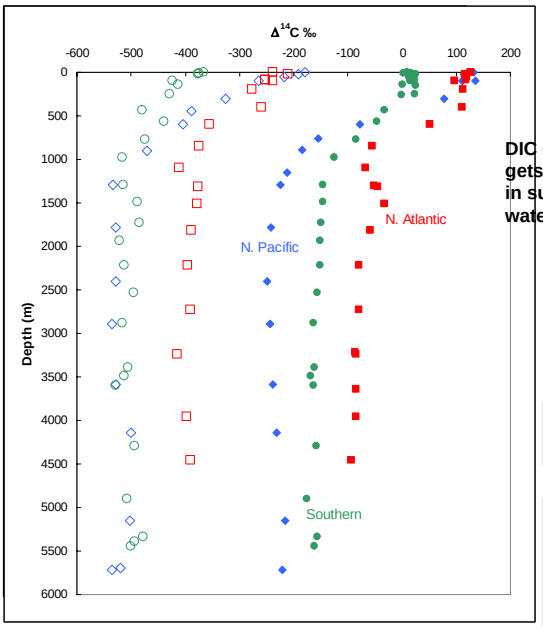
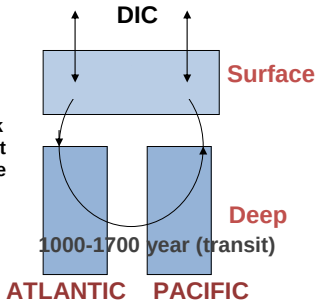
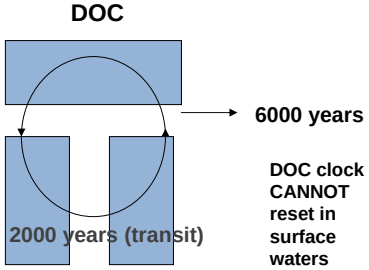
Distribution of Radiocarbon ($\Delta^{14}C$) in DOC (open) and DIC (closed)



DIC clock gets reset in surface waters

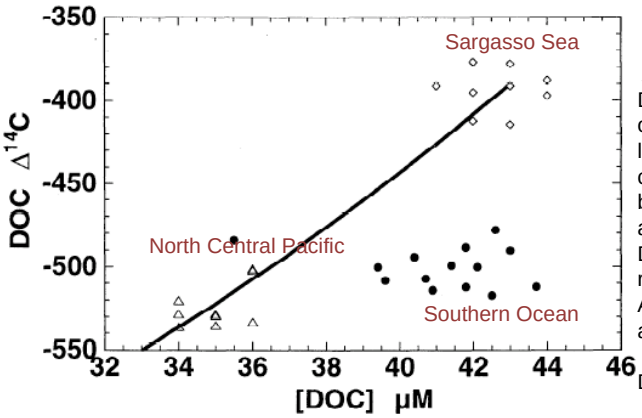




DOC clock CANNOT reset in surface waters

Druffel *et al.*, 1992; Druffel and Bauer, 2000.

Deep Ocean DOC Cycle

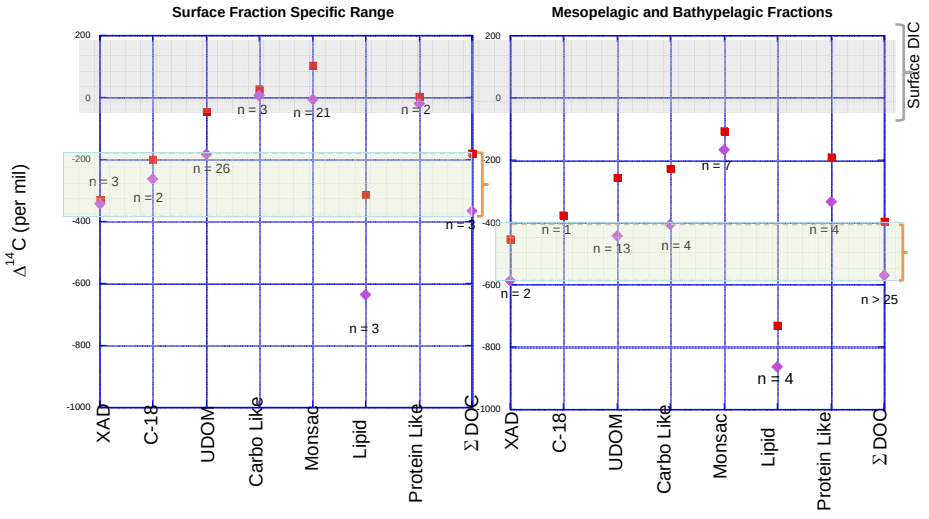


Δ ^{14}C of deep (>1500 m) DOC *versus* concentration of DOC at three oceanic locations. The curve is the calculated relationship between DOC concentration and Δ ^{14}C, assuming that DOC ^{14}C ages at a constant rate from the average North Atlantic value to the average N. Pacific value.

Druffel and Bauer, 2000

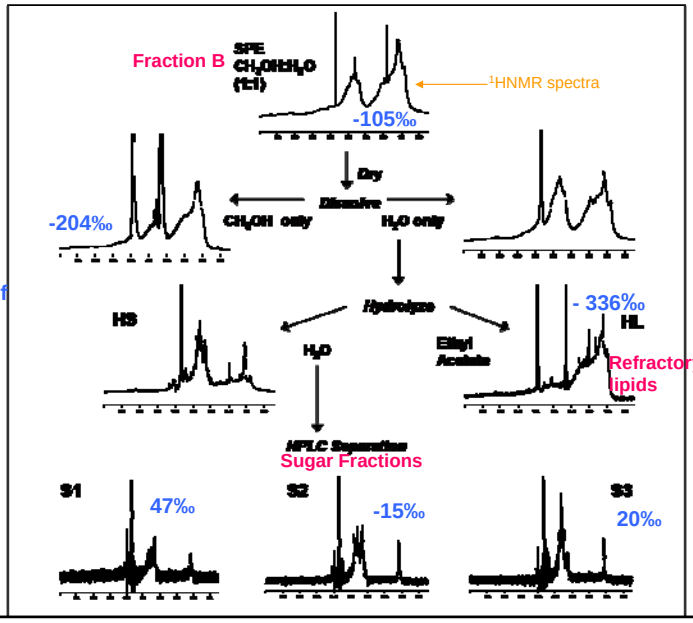
Passive aging, and removal of some DOC (~30%) without preference for a particular ^{14}C-group

Range of Δ ^{14}C Values Observed to Date



Druffel *et* al., 1992; Guo *et* al., 1996; Bauer *et* al., 1998; Santschi *et al*., 1998; Druffel and Bauer, 2000; Loh *et al*., 2004; Benner *et al*., 2004; Repeta and Aluwihare, 2006; De Jesus and Aluwihare., in prep.; Meador and Aluwihare, in prep.,

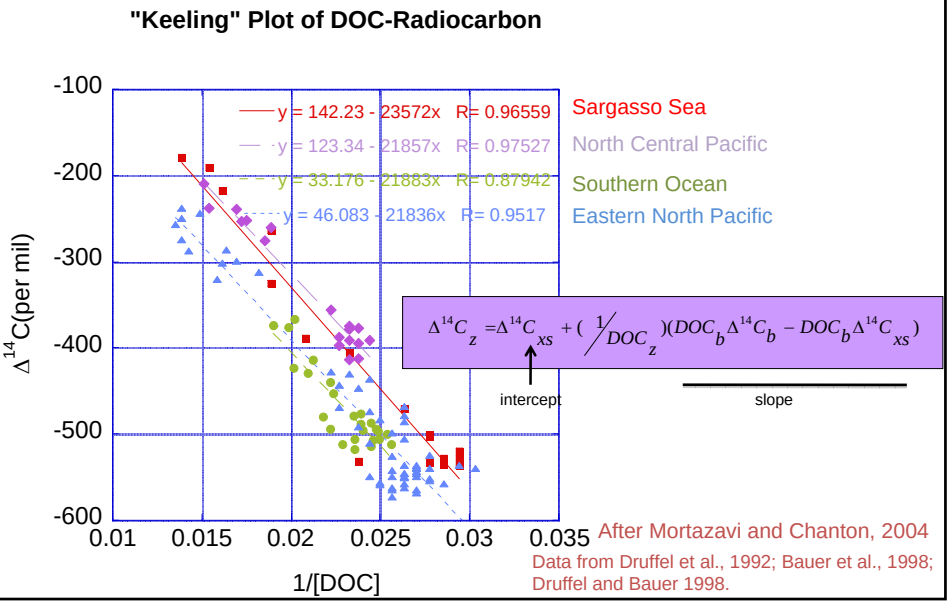
The Importance of Compound Specific Analyses



$\Delta^{14}C$ values of specific fractions

de Jesus & Aluwihare, in prep.

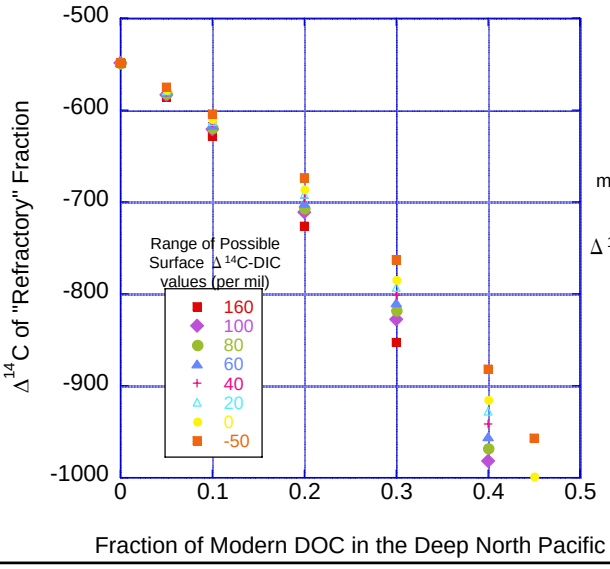
Two Major ^{14}C Groups Dominate The Reservoir?



After Mortazavi and Chanton, 2004

Data from Druffel et al., 1992; Bauer et al., 1998; Druffel and Bauer 1998.

Possible Modern-DOC Content of the Deep Ocean Reservoir (Modern DOC = $\Delta^{14}C$ Range of Surface DIC)



measured ↓ vary ↓

$\Delta^{14}C_{deep} = \Delta^{14}C_{DICsurf}(x) + \Delta^{14}C_{ref}(1-$

↑ Vary between -50‰ and +160‰ ↑ calculate

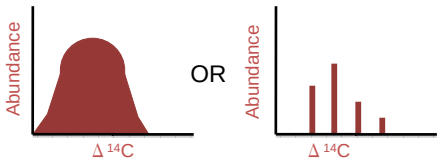
Based on deep ocean data from Bauer *et al.*, 1998.

Why is this an important research area in the context of the Marine Carbon Cycle?

❖ A continuum of ^{14}C signatures *versus* a few discrete ^{14}C groups.

➔ A fraction of the photosynthate escapes degradation each year and accumulates on long (>century) timescales (long-term C sequestration)

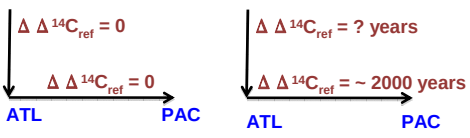
➔ Accumulating DOC has a few different sources each with discrete source-^{14}C signatures (C-sequestration is source related)



❖ Refractory/^{14}C-depleted DOC is well mixed *versus* ages between deep ocean basins

➔ homogenous source versus point source

➔ no loss of refractory DOC *vs* loss



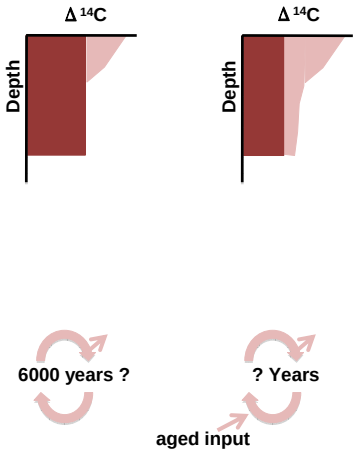
Why is this an important question in the context of the Marine Carbon Cycle?

❖Is there a significant stock of young DOC (< century-scale turnover) in the deep ocean.

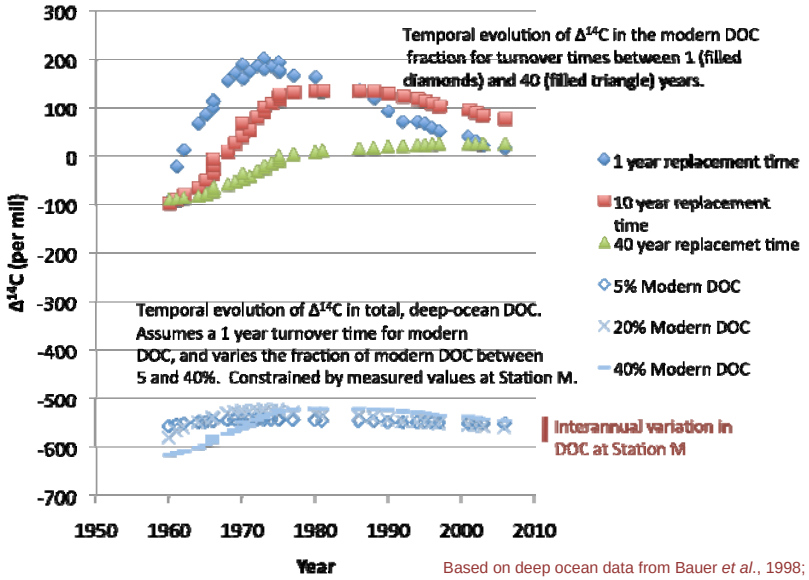
➔ Mechanisms of transport to depth (i.e., role of POC dissolution)?
➔ Turnover time of the young DOC?

❖What is the residence time of refractory DOC?

➔ What is the ^{14}C content of the oldest component?
➔ Is there a source of ^{14}C-depleted DOC to the ocean?



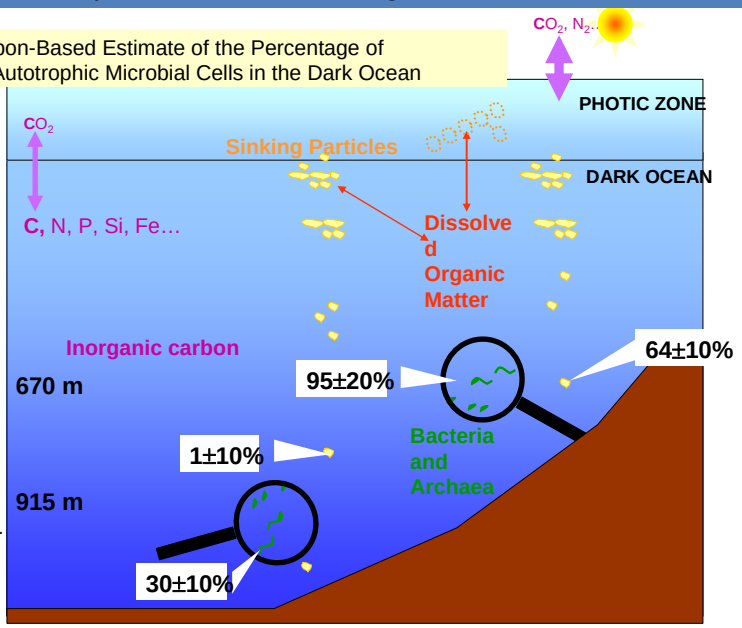
How Do We Identify The Presence of Modern DOC in the Deep Ocean? A $\Delta^{14}C$-DOC Time Series?



Based on deep ocean data from Bauer *et al.*, 1998; ^{14}C evolution model from Repeta and Aluwihare, 2006.

How Do We Identify The Presence of Modern DOC in the Deep Ocean? Free-Living Microbial DNA?

Radiocarbon-Based Estimate of the Percentage of (Chemo)Autotrophic Microbial Cells in the Dark Ocean



Hansman *et al.* Submitted.

How Do We Identify The Presence of Modern DOC in the Deep Ocean? The Definitive Solution

Compound-specific radiocarbon measurements of dissolved organic compounds are needed in order to identify the ^{14}C distribution in DOC.