Natural Estuarine Particles and their Uptake of Nitrogen in Estuaries

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Introduction

- Harmful algal blooms in coastal waters have been linked to dissolved organic nitrogen (DON) enrichment (Lewitus et al., 1999; Glibert et al., 2001; 2006).
- The partitioning and reactivity of organic N in rivers and estuaries are generally poorly quantified.
- As a result, there are major uncertainties regarding the factors controlling the flux of N from estuaries to coastal seas (see Figure 1).

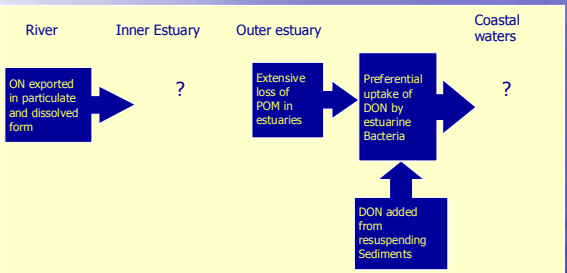


Fig. 1 Inputs and processes in the cycling of DON and particulate N in rivers, estuaries and coastal waters

- 50% of the riverine N flux to estuaries comprises particulate ON (Tappin, 2002).
- What controls the interaction of ON with particles?
- Do particle populations differ in their reactivity to DON?

Methods

- Water and suspended particulate material (SPM) were collected from the turbidity maximum zone (TMZ) of the Tamar Estuary, UK.
- Particle populations were separated into Permanently Suspended Particles (PSP) and Temporarily Suspended Particles (TSP) according to settling velocities.
- ^{14}C-labelled amino acids were added as model compounds to represent DON (Hedges et al., 1994). They were added to slurries at measured SPM levels (100-250 mg L^{-1}) in order to determine:

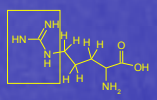
ABIOTIC REACTIVITY : physico-chemical interactions (sorption, desorption)

BIOTIC REACTIVITY : bacterial transformations (uptake, respiration)

- The experiments were carried out on particles and water collected at different seasons and the PSP and TSP fractions were added separately.

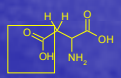
Three amino acids were used:

Arginine (ARG) is basic
pK_b of side chain = 1.52



Glycine (GLY) is neutral

Aspartic acid (ASP) is acidic
pK_b of side chain = 10.14



Since riverine SPM has an overall negative charge, basic compounds (low pK_b) should exhibit greatest partitioning onto the SPM if abiotic adsorption occurs.

Results and Discussion

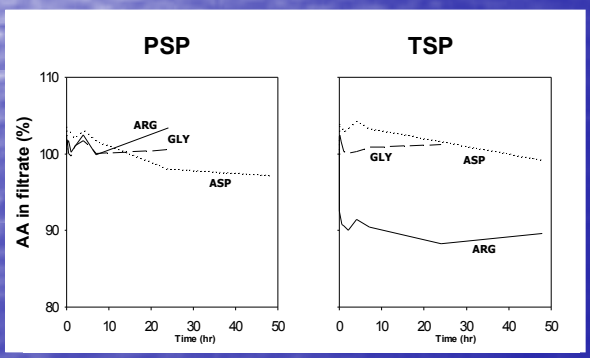


Fig. 2 Abiotic incubation of ^{14}C-Amino Acids with Summer TMZ SPM. Note that the y-axis scale begins at 80%.

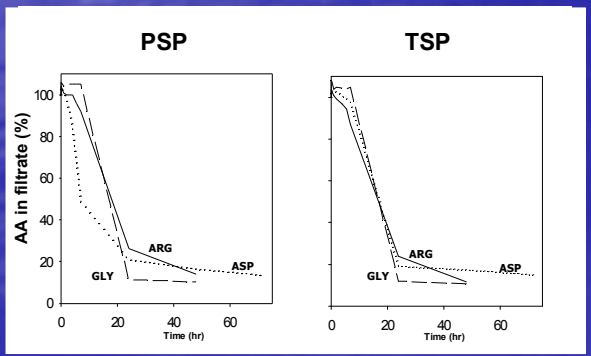


Fig. 3 Biotic incubation of ^{14}C-Amino Acids with Summer TMZ SPM

	Winter				Summer			
	PSP		TSP		PSP		TSP	
Amino acid	Abiotic	Biotic	Abiotic	Biotic	Abiotic	Biotic	Abiotic	Biotic
ARG	141	1.3	14	3.5	NP	2.1	19.2	2.2
GLY	41.7	2.2	42.3	2.3	NP	1.9	NP	1.9
ASP	NP	1.2	NP	2.4	69.4	2.3	257	1

Table 1 Calculated turnover times (days) for amino acids in incubation experiments using particles and water collected from the TMZ in the Tamar Estuary, UK (NP = no measured partitioning).

- **In abiotic experiments, ARG showed greatest adsorption onto TSP.**
- **However, abiotic sorption, where it occurred, was much slower than bacterial uptake onto particles (Figs. 2 and 3 represent the general trends observed).**
- **Based on the uptake data, bacteria can completely mineralize DON within the Tamar Estuary (Fig. 4). This may be true for other estuaries depending on particle residence times.**

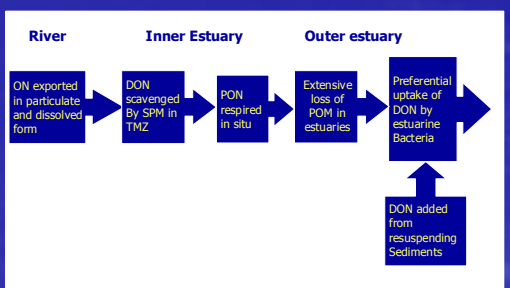


Fig. 4 Inputs and processes in the cycling of DON and particulate N in the Tamar Estuary, UK, including bacterially-mediated uptake of DON onto permanently and temporarily suspended particles.

Acknowledgements

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References

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