Nutrient Dynamics in the Ocean

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Lab Review 2008
AOML nutrient program
Contribution to NOAA’s mission

Ocean and Climate

Water mass tracer in ocean circulation
Quantifying oceanic uptake of CO$_2$

Ecosystem

Source and transport of nutrient
Cycling of nutrient within ecosystem
(e.g., sediment/water)
Outline

Cutting Edge technology development
  EPA standard methods
  Underway instrumentation
  Liquid waveguide

Preeminent Research
  Phosphorus cycle in Florida
  Nutrient input to coastal water
  Repeat Hydrography
• nitrate/nitrite
• ammonium
• silicate
• total N
• total P
Mapping ammonia dispersion in an oceanic outfall

Amomthammarong & Zhang 2008
Sensitivity Enhancement by Liquid Waveguide

$n_{\text{teflon}} = 1.31$

$n_{\text{water}} = 1.33$

Zhang 2006 Analytical Science
Oceanic photosynthesis observed from diel cycle of nitrate at nM levels

Zhang et al, GRL 2001
Parameters essential to model sediment/water exchange of phosphate

1. Distribution coefficient
   \[ K_d = \frac{P_{\text{sediment}}}{P_{\text{water}}} \]

2. Zero Equilibrium Phosphate Concentration (EPC₀)
   water P concentration at which no exchange of P between sediment and water
Sorption experiments to quantify $K_d$ and $EPC_0$
Spatial distribution of $EPC_0$ and $P_{exch}$ in Florida Bay

![Spatial distribution of $EPC_0$ and $P_{exch}$ in Florida Bay](image)

$EPC_0$

$P_{exch}$

Zhang & Huang, ES&T 2007
Spatial distribution of $K_d$ and Fe in Florida Bay

**Diagram:**
- **$K_d$ (L/g)**
- **FeO (umol/g)**

Longitude (W):
-81.2 -81.1 -81.0 -80.9 -80.8 -80.7 -80.6 -80.5 -80.4 -80.3

Latitude (N):
25.3 -25.2 -25.1 -25.0 -24.9 -24.8
0 -0.1 -0.2 -0.3 -0.4 -0.5 -0.6
0.5 -1.0 -1.5 -2.0 -2.5 -3.0 -3.5 -4.0
0.5 -1.0 -1.5 -2.0 -2.5 -3.0 -3.5 -4.0
EPC$_0$ and $K_d$ as a function of $P_{\text{exch}}$ in Florida Bay

Zhang & Huang, ES&T 2007

![Graph showing the relationship between $P_{\text{exch}}$ and $K_d$, as well as $EPC_0$. The graph includes data points and fitted curves for $K_d$ and $EPC_0$.](image)
Repeat Hydrography CO₂/tracer Program hydrographic sections
Nitrate in North Atlantic
Tide induced nutrient flux to coastal waters
Outlook & challenges

Nutrient Dynamics/Ecosystem Functioning

• Shipboard underway measurement for oligotrophic ecosystem

• In situ nutrient sensors for time-series monitoring (e.g. coral reefs)

• Developing Certified Reference Materials (CRM) to Improve accuracy