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"Benthic-Pelagic Coupling"

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Benthic-Pelagic Coupling

I. What is benthic-pelagic coupling?

-trophic and geochemical linkage between the water column and benthos
-the intensity of surface primary production affects carbon flux to the benthos—surface production and bottom sedimentation often mirror each other!

II. Why should we care?

A. Geochemical cycles – remineralizes organic carbon to inorganic carbon (CO_2). Without this geochemical cycling the benthos would become a deep pool of organic sludge with a high oxygen demand.
B. Regulates global climate cycles and builds fossil fuels – less than 1% of organic carbon is buried in the seafloor. These deposits may eventualy produce fossil fuels. The burial of carbon also maintains a balance of CO_2 in the atmosphere, avoiding a buildiup of CO_2.
C. Fisheries production – Areas of the seafloor with high benthic biomass (typically associated with high surface primary production) often support productive crustacean and flatfish fisheries.

III What are the primary food sources for benthos?

A. Allochthonous carbon from terrestrial and freshwater origin
B. Autochthonous carbon from primary production in euphotic zone, benthic algae, macroalgae, seagrasses, microbial organic matter

III. What are the primary factors modifying food availability?

A. Depth – food decreases with depth (25-60% reaches bottom in shallow water (< 200 m), 1-10% reaches deep sea).
B. Latitude – food increases with latitude

IV. How do you measure the flux of POC to the benthos?

It depends on the time-scale of interest.
A. Long time scale (e.g., years, months) – Hargrave's (1973) model relating benthic oxygen consumption to surface primary production, and to the mean annual mixed layer depth.

$C_o = a(C_i)b/(Z_m)c$
Where C_o = carbon equivalent of annual sediment oxygen uptake
C_i = annual primay production
Z_m = mixed layer depth
a,b,c = constants

B. Short time scales (e.g., days, weeks) – direct measurements using sediment traps.

V. Components and rates of particle flux

A. Vertical sedimentation
B. Lateral advection (may transport more POM than vertical flux)
C. Biodeposition (e.g., psuedofeces)
D. Rates of flux: deep ocean = 1-100 mg*C*m^2*d; nutrient-rich coastal water = 30-600 mg*C*m^2*d

VI. How does the timing and amount of food influence benthic biomass and community structure?

Seasonal pulsed inputs of OC (e.g., spring phytoplankton blooms) may be one of the only sources of environmental variability to otherwise constant deep sea environments.

Timing & food availability	Benthic community
1. high food input	Dominated by species which maximize turnover (rapid growth, high reproductive rate)
2. low food-unpredictable input	Maximum species diversity due to evolution of complex feeding strategies (low growth, low turnover)
3. low food-unpredictable input	Slow growing, maximize individual biomass to allow persistence during periods of starvation.

Soft Sediments I.

Benthic-Pelagic Coupling, Animal-Sediment Relationships, Energy Flow & Diagenesis

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