BENTHIC NUTRIENT REGENERATION IN THE CENTRAL GREAT BARRIER REEF REGION

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Despite the acknowledged importance of the regeneration of dissolved inorganic nutrients from the benthos to the water column for primary production, it is astonishing that so little of such work has been conducted in the Great Barrier Reef province. A few studies have examined water column concentrations in relation to water mass movements (e.g. Walker and O'Donnell, 1981, Andrews and Gentien, 1982), but only two published studies have examined benthic nutrient fluxes either in situ or in the laboratory (Hansen et al 1987; Ullman and Sandstrom, 1987).

From nearshore sediments of Bowling Green Bay (Central GBR Lagoon), Ullman and Sandstrom (1987) measured fluxes in laboratory cores ranging from -23 to 28, -154 to + 890 and -990 to + 1750 $\mu mol \cdot m^{-2} \cdot d^{-1}$ for PO_4^{3-}, total nitrogen species (NH_4^+ + NO_2^- + NO_3^-) and $Si(OH)_4^-$, respectively. Similarly, in Davies Reef lagoon, Hansen et al (1987) recorded low and variable fluxes (-28 to + 1 for PO_4^{3-}, +57 to +806 for $Si(OH)_4^-$ and + 143 to +544 for ΣN).

Recent and ongoing nutrient regeneration experiments conducted by the author at AIMS have found similarly low and variable benthic fluxes measured from intact box cores and bell chambers taken from intertidal and subtidal sediments in the Hinchinbrook Island - Murray River - Brook Islands region. The results suggest that proximity to mangrove forests does not apparently result in greater rates of nutrient flux (Table 1).

Of greater significance is the fact that solute fluxes calculated using Fick's diffusive law (Berner, 1980) predict generally higher rates of flux for all of the inorganic species compared to the measured fluxes (Ullman and Sandstrom, 1987; Alongi, in prep.). Taken together, our data reveal a strong vertical concentration gradient with sediment depth at Bowling Green Bay and in the Hinchinbrook region for all nutrients implying the existence of strong nutrient fluxes from the sediments to the overlying water.

Comparison of fluxes from the GBR province with those from temperate coastal and estuarine sediments reveals that the fluxes from the GBR are substantially below the mean fluxes observed in other environments, although there is a fair degree of overlap (Table 1). Why such low fluxes despite evidence of strong vertical concentration gradients? Two possible reasons are: dilution by terrigenous inorganic debris low in nutrients and relatively unreactive, and low rates of plankton detritus deposition coupled with high rates of benthic bacterial production. Indeed, bacterial production rates in the Hinchinbrook Island region range from 0.5 - 2.3 $gC \cdot m^{-2} \cdot d^{-1}$ indicating that nutrient consumption is occurring at or near the sediment-water interface (Alongi, in prep.).

Table 1 DISSOLVED NUTRIENT FLUXES ($\mu mol \cdot m^{-2} \cdot d^{-1}$)

Location	PO_4^{3-}	Si	NH_4^+	$NO_2^- + NO_3^-$	Reference
Narragansett Bay (20°C)	160-7700	1800-1700	900-1800		Elderfield et al (1981)
Long Island Sound (22-27°)	60-320	0-19800	-1000-8000		Aller (1980); Aller and Benninger (1981)
Potomac Rivet (20°C)	-600-4000	1000-25000	-3100-26000		Callender and Hammond (1982)
Bowling Green Bay (22°)	-23-28	-990-1750	-160-760	-33-150	Ullman and Sandstrotn (1987)
Davies Reef Lagoon (22°C)	-28-1	+ 57-800	+ 143-544	0-10	Hansen et al (1987)
Missionary Bay - Murray River Region (20°C)	-34-79	+522-3144	-624-2469	-75-250	Alongi, in prep.

MANAGEMENT IMPLICATIONS

It is probable that nutrient fluxes from GBR sediments are enhanced only during periods of extensive river runoff (e.g. the Burdekin floods) and storm surges (e.g. cyclones) which result in significant sediment resuspension. The calculations of Ullman and Sandstrom (1987) predict the resuspension of I cm of GBR inshore sediment would lead to moderate increases in water column nutrient concentrations, particularly for nitrogen species. However, no simulation experiments have been conducted to test this hypothesis. It is evident that benthic nutrient fluxes in the GBR are finely tuned to physical processes occurring on land and in the water column. However, before correct management decisions (e.g. waste disposal criteria) can be made, more observations, preferably of a long-term nature of benthic nutrient fluxes are necessary-particularly at or near sites of future anthropogenic input.

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