

Particulate organic matter fluxes in a Tuamotu atoll lagoon (French Polynesia)

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ABSTRACT: The standing stock and chemical composition of suspended particles (< 35 µm) were monitored in the lagoon of Tikehau Atoll from 1983 to 1987 and in surrounding oceanic waters (upper 250 m) during 4 cruises. Trapping rate of particulate material was measured between 1986 and 1987 and net export of particulate organic matter (POM) was roughly estimated using monthly average lagoon POM concentration and monthly average flow of water measured in the passage and the reef-flat spillways. Results showed that deep chlorophyll maxima in oceanic waters could reach 0.24 mg m⁻³ and were observed between 100 and 200 m even when ATP, POC, PON and POP concentrations were higher in the upper 100 m. POM concentration was homogeneous in the lagoon but varied considerably with time especially following 2 hurricanes in 1983. POM concentration was 30 to 40 % higher in samples taken close to the bottom than in the water column. An oceanic station near the atoll was strongly influenced by the lagoonal discharge but POC export from the lagoon to the ocean represents only 6 % of phytoplankton production. The POM content of Tikehau lagoon lies within the range recorded for coral reef areas and is made up of suspended particles 50 % of which are smaller than 5 µm. Their sedimentation (350 mg C m⁻² d⁻¹) represents 80 % of phytoplankton production.

INTRODUCTION

Of the 84 atolls of French Polynesia, 76 constitute the Archipelago of Tuamotu. The lagoons of the archipelago play an important role in the French Polynesian economy: cultured pearls from pearl oyster aquacultures in Tuamotu atoll lagoons are French Polynesia's major export; in addition, lagoon fisheries supply a major part of the local fish requirement.

An estimate of lagoonal productivity is necessary to assess the lagoons' potential for exploitation. Such estimates are difficult to make due to the diversity of lagoonal primary producers: phytoplankton, macrophytes, sand microphytes, and epilithic and symbiotic microphytes. Moreover, the flux of detritus particles flowing from the coral reefs into the lagoon may also be important to lagoon organisms (Gerber & Marshall 1982). The particulate organic matter (POM) content of the water column seems to be a good index of lagoon productivity (Charpy 1985). However, so far, only one study has been published on the organic matter found in Polynesian lagoonal waters (Charpy 1985). Other lagoonal studies dealt with phytoplankton productivity (Sournia & Ricard 1975, 1976, Delesalle 1985, Charpy-Roubaud et al. 1989) or phytobenthos productivity (Sournia 1976, Charpy-Roubaud 1988).

Measurements of organic material deposition are very important. Nutrient requirements for lagoonal production may be met through recycling of autochthonous material in the sediments. One of the principal factors which governs rates of nutrient regeneration from sediments is the amount of organic matter incorporated into those sediments from the water above (Koop & Larkum 1987).

Polynesian atolls may be divided into open and closed atolls. The export rate of organic material from an open atoll may be considered as the net production of the atoll. Comparisons between the export of POM and other lagoonal fluxes allows an estimation of the relative importance of lagoonal fluxes and the influence of atoll morphology on lagoonal communities. We studied the abundance, rate of deposition on the lagoon floor and export rate of POM in an open atoll of the Tuamotu archipelago from 1983 to 1987.

STUDY SITE

The atoll chosen for study was Tikehau, situated in the northwest of the Tuamotu Archipelago; its geomorphological characteristics make it suitable model of a mid-size open atoll.