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ENVIRONMENTAL CONDITIONS AND HEAVY METAL CONTENT OF MARINE ORGANISMS FROM ATOLLS OF THE PACIFIC OCEAN

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ABSTRACT

Contents of Fe, Mn, Cu, Zn and Pb were determined in Tridacnidae and Caulerpaceae inhabiting the relatively unpolluted shallow waters of two coral islands in the Southwestern Pacific. Differences in the geochemical properties of the island environments influence the mineral composition of the organisms. Further, the differential accumulation of heavy metals by organs of *Tridacna* may be due to their biochemical functions and the degree of exposure to ambient seawater.

INTRODUCTION

The increase of stress on the marine environment brought about by technology makes urgent the evaluation and monitoring of the accumulation level of pollutants in marine organisms. It must start with a determination of the *initial* level of mineral load in order to have a sound basis for ensuing assessment.

This paper deals with contents of some heavy metals in the tissues of *Tridacna squamosa* and *Caulerpa urvilliana*, common inhabitants of the shallow waters of Suvorov and Pukapuka (Danger) Atolls, where pollution has not yet crept in. These two species may serve as biological indicators for future monitoring schemes on heavy metal pollution.

MATERIALS AND METHODS

Studies were carried out in the two atolls in 1977. On the Suvorov Atoll, individuals of *Tridacna squamosa* and *Caulerpa urvilliana* were collected near the Anchorage Island situated northeast of the reef ring, at 2 m depth. On the Pukapuka Atoll, samples were collected on the coral heads of the reef flat.

Thalli of the seaweeds, and muscles, gills and liver of the bivalves were obtained as samples. The procedure for preparation and treatment of the samples was described by Khristoforova et al. (1979) and Khristoforova and Bogdanova (1980).

RESULTS

Table 1 lists the metal contents determined. In *Caulerpa urvilliana*, Fe, Zn and Cu concentrations were lower for individuals from Suvorov atoll than those from Pukapuka. The seaweeds differed significantly in Fe content (19.4 and 54.5 ppm, respectively).

Soft tissues of molluscs from both atolls also differed in their metal concentrations. Significantly higher concentrations were obtained in *Tridacna* from the Pukapuka Atoll.

Table 1. Metal content ($\mu g \cdot g^{-1}$ dry weight) of marine organisms from atolls.

Location	Species and Tissues	Fe	Mn	Zn	Cu
Suvorov Atoll, wall reef flat on a passage to lagoon	*Caulerpa urvilliana*	19.4	9.5	3.7	1.2
	Tridacna squamosa				
	muscle	4.0	0.2	1.6	0.8
	gill	44.7	3.5	27.0	2.7
	liver	10.0	15.0	17.0	3.0
Pukapuka Atoll, inner reef flat	*Caulerpa urvilliana*	54.5	7.3	9.0	2.3
	Tridacna squamosa				
	muscle	10.1	0.5	14.0	0.9
	gill	111.0	4.0	58.0	6.4
	liver	21.4	12.0	89.0	3.7

Thus, the algae as well as the molluscs from the Pukapuka Atoll contained greater amounts of Fe, Zn, and Cu; but not Mn.

DISCUSSION AND CONCLUSION

Suvorov and Pukapuka Atolls are remote oceanic islands, rather isolated from continents (Voronov et al. 1977). They are reef formations on submerged volcanic cones. In spite of the identical nature of rocks forming them, and the similar position they occupy in the system of oceanic structures, each atoll has its own ecological peculiarities. The lagoon of the Suvorov Atoll is deep (up to 90 m), has a passage to and an active water exchange with the ocean. Element concentrations in water within this atoll differed only slightly from those outside the outer reef flat (Khristoforova and Bogdanova 1980). It is assumed, therefore, that the microelement composition of seaweeds and molluscs of the lagoon depends basically on the composition of the oceanic water entering the lagoon.

Pukapuka Atoll is — in contrast to Suvorov Atoll — populated; it is formed by a closed-ring reef flat and has a shallow lagoon (up to 15 m), well-heated and with increasing concentrations of elements towards its center. Probably, this explains why the metal contents in *Caulerpa* and *Tridacna* were greater here than in the *Suvorov* Atoll. For example, *C. urvilliana* in Pukapuka contained Cu, Zn and Fe 1.8, 2.4 and 2.7 times more than in Suvorov Atoll.

The organs and tissues of *Tridacna* most actively accumulating the heavy metals were subjected to further analysis. It was found that the muscles were impoverished of these elements compared to the gills and liver, regardless of habitat. This difference could be attributed to the specific biochemical functions of the organs and their degree of exposure to the ambient seawater. For example, the gills, which function as filters accumulate mostly Fe that exists in water in particulate form. The liver concentrates mostly Zn because assimilation of food in bivalves proceeds to a great extent in this organ.

Finally, it could be concluded that even in the most remote and clean oceanic sites situated far from technologic and natural sources of pollution, as in the coastal zones of the Pacific Ocean Atolls, the regional ecological conditions cause the difference in heavy metal content among individuals of the same species.

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