# TRACKING DISSOLVED TRACE METALS IN SEAWATER USING LIVING *AMPHISTEGINA LOBIFERA* (BENTHIC FORAMINIFERA) TESTS FROM HAIFA BAY

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**Abstract**

The purpose of this study was to examine the use of metal concentrations in living benthic foraminiferal tests ( *Amphistegina lobifera)* as proxy for dissolved metal concentrations in seawater. Living specimens were sampled at two stations and surface seawater was collected at the same time in Haifa Bay, in 8 bi-monthly cruises during 2003-04. The variations of the minor (Mg, Sr, Li, B) elements ratios in *A. lobifera* seems to be related to variations in its growth rates while the trace element ratios such as Ni, Cd and Pb seems to be effected mainly by the ambient seawater fluctuation. A better understanding of the foraminiferal life cycle and the incorporation of HM in their tests will enable the use of foraminifera in assessing short and long-term trends of HM concentrations in coastal seawater.

*Keywords : Foraminifera, Eastern Mediterranean, Pollution, Trace Elements.*

The coastal waters of Haifa Bay, Israel are exposed to heavy metals (HM) introduced from point (Qishon and Na'aman Rivers) and diffusive sources. The dissolve HM concentrations in the bay and the shallow water of the Israeli Mediterranean coast are poorly known due to their extremely low concentrations and analytical complexity. Thus, it is difficult to establish a routine long-term monitoring program and assess water quality in terms of time-integrated ecological environmental criteria. The aim of this study was to use metal concentrations in calcareous tests of living benthic foraminifera, as a proxy for dissolved metal concentrations in seawater.

The working hypothesis in this study is that benthic foraminifera precipitate their tests directly from sea water, reflecting a time integrated dissolved trace element concentration in ambient sea water. The tests precipitated by *Amphistegina lobifera* establish an equilibrium state with the ambient seawater represented by a metal explicit distribution coefficient. The analysis of foraminiferal tests follows a cleaning procedure that removes detritus and mainly the inner cytoplasm.

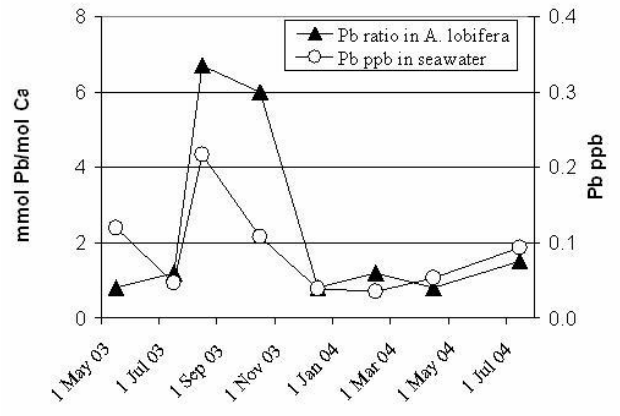


Fig. 1. The variations of Pb in living *Amphistegina lobifera* (benthic foraminifera) tests and ambient seawater from Haifa Bay, Israel.

*A. lobifera*, symbiont-bearing larger foraminifera, lives in Haifa Bay in large numbers on rocky substrate. It reproduces once a year with juveniles ( 0.4 mg, on avg.) dominating during summer and adults ( 1.5 mg, on avg.) during late fall to winter. This differs from other shallow tropical environments where 2-4 reproduction cycles/annum occur. Living specimens were sampled at two stations at 10 m water depth and surface seawater were collected at the same time from 6 representative stations in Haifa Bay, in 8 bi-monthly cruises during 2003-04. Most of the dissolved heavy metals are enriched in Haifa Bay seawater by a factor of 3-10 compared with a control clean station located 100 km offshore the Israeli Mediterranean coast. Mg concentrations in sea water vary seasonally while some heavy metal concentrations (Ni, Cd) are unrelated to seasonality and probably reflect short term influx of metals from land-base sources.

The variations of the minor (Mg, Sr, Li, B) elements ratios (element/Ca) in *A. lobifera* calcareous tests correlate to variations in growth rates, high in summer (2-3%/day), and low in winter (<0.5%/day). The variations of Ni, Cd and Pb (Figure 1) in *A. lobifera* tests seems to be affected by their ambient seawater fluctuations despite the differences in time-scale represented by each of these matrices (sporadic - seawater) vs. prolonged growth period of the foraminiferal test.

We have estimated the trace metal content in *A. lobifera* tests using the highest published values of partition coefficient [Lea 1999] and the measured dissolved metal content in seawater at a control station 100km offshore (mid of the oligotrophic Levantine basin). The comparison between the calculated and measured metal content in foraminifera tests from Haifa Bay revealed an enrichment in the measured values by a factor of up to 20 for Cu, Zn and Cd and less so (<3) for V, U and Sr. This indicates that the seawater in Haifa Bay is continuously enriched in dissolved metals as compared to the open sea, and the minimal measured values of dissolved metals are usually exceptional.

A better understanding of the foraminiferal life cycle and the incorporation of trace elements in their tests will enable their use for assessing short and long-term trends of dissolved metal concentrations in coastal seawater.

**Reference**

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