Environmental response of benthic foraminifera in Asalooye coastline sediments (Persian Gulf)

***Masoomeh Sohrabi-Mollayousefi, Maryam Sahba**

*Department of geology, Islamshahr Branch, Islamic Azad University
m_sohrabi14@yahoo.com

Department of geology, Science and Research Branch of Tehran, Islamic Azad University.
m_sahba224@yahoo.com

Abstract

Benthic foraminifera of the Persian Gulf and them distribution were investigated in Asalooye coastline sediments in year 2009. Asalooye is located in Booshehr province in south of Iran. The studied region is near the gas refineries and Petrochemicals Company that it is one of the most important places of toxic and heavy metals. The faunal studies were accomplished by measurement of physico-chemical properties of water and geochemical analyses of surface sediments. Physico-chemical properties included the salinity, temperature, dissolved oxygen and acidity of water was measured on board. The temperature and salinity showed a pronounced seasonality. Average of temperature was determined 23.5 ^{o} C. Acidity of water didn't show important changes. Average of dissolved oxygen exceeded 6.1 mg/lit. Samples for geochemical analysis were powdered and amount of Ba, Sr, Cu, Zn, Pb, Ni and Cr was determined by X.R.F examinations. The samples for foraminifer's analysis were stored in a fridge for 8 hours to effect a sufficient staining with Rose Bengal. The samples were first passed and washed through 4 sieves (50 μ, 100μ, 0.5mm and 1 mm). After drying foraminifera tests were picked out, then normal and abnormal tests were counted separately. The abundances were expressed as a number of specimens per 1cm^3 of sediment. The main species were photographed by using a Scanning Electronic Microscope (SEM). The living benthic foraminifera communities in Asalooye coastline sediments were dominated Elphidium ceraticulatum, Amphistegina lobifera, Dendritina ambigua, Quinqueloculina agglutinans , Quinqueloculina seminulum were commen. In this research, we recorded high frequencies of test abnormalities. The majority of abnormal tests were observed in Quinqueloculina agglutinans, Quinqueloculina seminulum. Elphidium ceraticulatum is highly opportunistic and capable to tolerate elevated levels of nutrients and trace metals.

Keywords: *Persian gulf, Elphidium ceraticulatum, Asalooye, Heavy metals, Abnormal foraminifera.*

Introduction

Booshehr province is one of the south's west of Iran that its coastline has much pollution of hydro-carbon and oil. In addition to the gas refineries and Petrochemicals industries were located in Asalooye city of Booshehr province. The aim of this study is to determine the possible causes of abnormality on benthic foraminifer's tests.

Benthic foraminifera are single-celled organisms similar to amoeboid organisms in cell structure. Foraminifera are covered with an organic test that varies from a single chamber with an aperture to calcite wall or agglomeration of mineral grains. Foraminifera occupy a wide range of marine environments, from brackish estuaries to the deep ocean basins (Ernest et al, 2006). They are good biomarkers for environmental pollution of natural or artificial causes.

The heavy metals adversely affect the biota and cause morphological abnormalities in individuals. Benthic foraminifera of the Persian Gulf were investigated in 2009. By systematical and ecological studies were determined foraminiferal assemblages in coastline sediments of Asalooye.

Material and method

The current study is based on 14 surface sediment samples collected in May 2008 on 2 cruises. The surface samples were placed into a glass vial thoroughly mixed and subsamples for organic and inorganic geochemical analyses were taken from this mixture at first. The remaining was transferred to a PVC vial, and preserved and stained with a solution of 2 grams Rose Bengal per litre ethanol in order to mark living foraminifers (Murray et al, 2000).

According to Physicochemical properties measurements the salinity, temperature, acidity and dissolved oxygen content of the super standing water in core tube were measured on board.

For geochemical analysis subsamples were freeze-dried and powdered and amount of Ba, Sr, Cu, Zn, Pb, Ni and Cr was determined by X.R.F examinations.

The subsamples for foraminifera analysis were stored in a fridge for 8 hours to effect a sufficient staining with Rose Bangal. Living individuals are recognised by statining (Biocenosis). The samples were first passed and washed through 4 sieves (50 μ, 100μ, 0.5mm and 1 mm). After drying foraminifera tests were picked out, both normal and abnormal tests were counted separately.

Results and Conclusion

The temperature and salinity showed a pronounced seasonality. Average of temperature was determined 23.5 ^{o} C. Acidity of water didn't show important changes. Average of dissolved oxygen exceeded 6.1 mg/lit .

The concentrations of Cu, Zn, Pb, Ni and Cr in subsamples of Asalooye were showed in table 3. Accumulations of elements have relation to grain size of sediments, mean' while amount of them in muddy sediments is more than sandy.

The surface sediment pollution by Cu, Zn, Pb, Ni and Cr principally could be considered as moderate because the levels of metals are comparable to elsewhere in Persian Gulf.

According to previous studies mean concentration of Cu is increased but the others didn't show important changes.

The living benthic foraminiferal communities were dominated by: *Elphidium ceraticulatum*. The other common speices of benthic foraminifera in Asalooye coast line sediments are *Ammonia beccarii, Amphistegina lobifora, Cymaloporetta sp., Dendritina ambigua, Penereplis planatus, Pseudohauerina sp. Pseudohauerinella dissidens, Quniqueloqulina agglotinanas, Quniqulina seminulum Rotalia trochidiformis, Rupertianella rupertiana, Spiroloculina depressa, Spiroloculina excavata, Triloculina inflata, Triloculina tricarinata*.

Our results infer that genra or species with hylaine tests have more abundancy than the porcelanose or aglutina tests. Aboundance of living individuals (or biocenosis) more than dead forms of foraminifera (or taphocenosis). Investigation on test size of foraminidera showed living individuals in studied region is smaller than normal size.

The results of compration between Diementions of test and grain size of sedimentary bed showed silty or muddy beds have small or tiny tests. In this type beds amount af total orghanic matter is high and concentration of metals spacially Cu is more than sanddy beds.
According to Alve (1995) aboundant and geographicaly wiedspread species are to be considered as most tolerant to environmental pollution. *Ammonia beccarii* is commenly frequnent in coastal environmemnts(Stouff et al. 1999). Species of Ammonia beccarii is aboundance because its opportunistic behavior and high potential to survieve under high input of nutrients and metals concentration. In our studied region *Elphidium ceraticulatum* has high aboundacity but with abnormal test. The majority of abnormal tests were observed in *Ammonia beccarii* and *Elphidium ceraticulatum*. However during spring time we observed an increase in aboundance of abnormal tests, wich was correlated to high metal levels. We suggest that this mirrors the production of benthic foraminifera during spring, and the juveniles were especially sensitive to environmental stress.

References

[1] Alev, E. *Benthic foraminiferal responses to estuarine pollution*, J.Foramin Res., 1995, 25, 3, 190-203.

[2] Boyle, E. A., *Cadmium, zinc, copper, and barium in foraminifera tests, Earth Planet*. Sci. Lett.1981, 53, 11 –35.

[3] Ernest, S. R., Morvan, J., Geslin, E., Le Bihan, A., and Jorissen, F. J. - *Benthic foraminiferal response to experimentally induced Erika oil pollution,* 2006, 61, 76-93.

[4] Dmitrenko, O.B., *Environmental reconstruction based on heavy metals, Diatoms and Benthic foraminifers in the Isahaya Reclamation Are, Nagasaki, Japan*, 2004, J.JEM, 1, 83-105.

[5] Le Cadre, V. and Debenay, J. P. - *Morphological and cytological responses of Ammonia (foraminifera) to copper contamination: Implication for the use of foraminifera as bioindicators of pollution,* Environ, Pollut. 2006, 143, 304–317.

[6] Murray, J.W. *Ecology and pale ecology of Benthic Foraminifera,* 1991, Bath press, Avon, 397.

[7] Sch¨onfeld, J. Numberger, L. *The benthic foraminiferal response to the 2004 spring bloom in the western Baltic Sea*, 2007, Mar. Micropaleontol., 65, 78–95.

[8] Stouff, V., Geslin, E., Debenay, J.-P., and Lesourd, M. Origin of morphological abnormalities in *Ammonia* (foraminifera): studies in laboratory and natural environments, J. Foramin. Res. 1999, 29(2), 152–170.

Table 1- Summary of foraminifer's population in studied region

NO	Genera & Species	Biocensis	Taphocenosis
1	*Elphidium ceraticulatum*	70	12
2	*Ammonia beccarii*	20	-
3	*Amphistegina lobifora*	54	23
4	*Cymaloporetta sp.*	22	5
5	*Dendritina ambigua*	43	12
6	*Peneroplis planatus*	28	8
7	*Pseudohauerina sp.*	11	1
8	*Pseudohauerinella dissidens*	25	3
9	*Quniqueloqulina agglutinans,*	30	11
10	*Quniqueloqulina seminulum*	40	20
11	*Rotalia trochidiformis*	21	10
12	*Rupertinella rupertiana,*	5	-
13	*Spiroloculina depressa*	7	-
14	*Spiroloculina excavata*	6	-
15	*Triloculina inflata*	21	18
16	*Triloculina tricarinata*	33	21

Table 2 - Mean concentration of Cu, Zn, Pb, Ni and Cr (ppm)

Cu	Zn	Pb	Ni	Cr
33	34	4	17	4

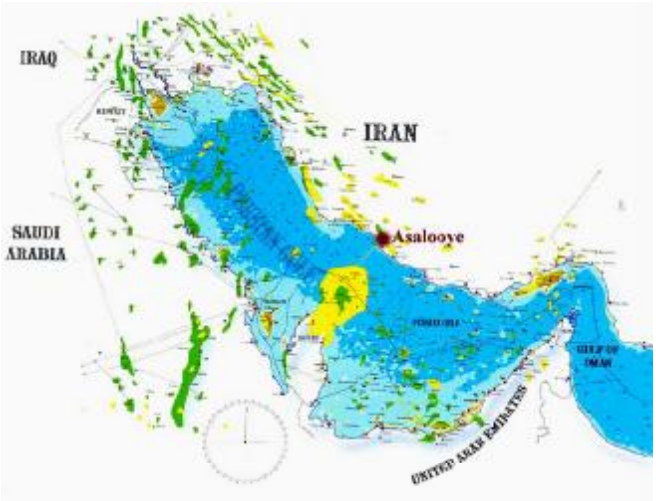
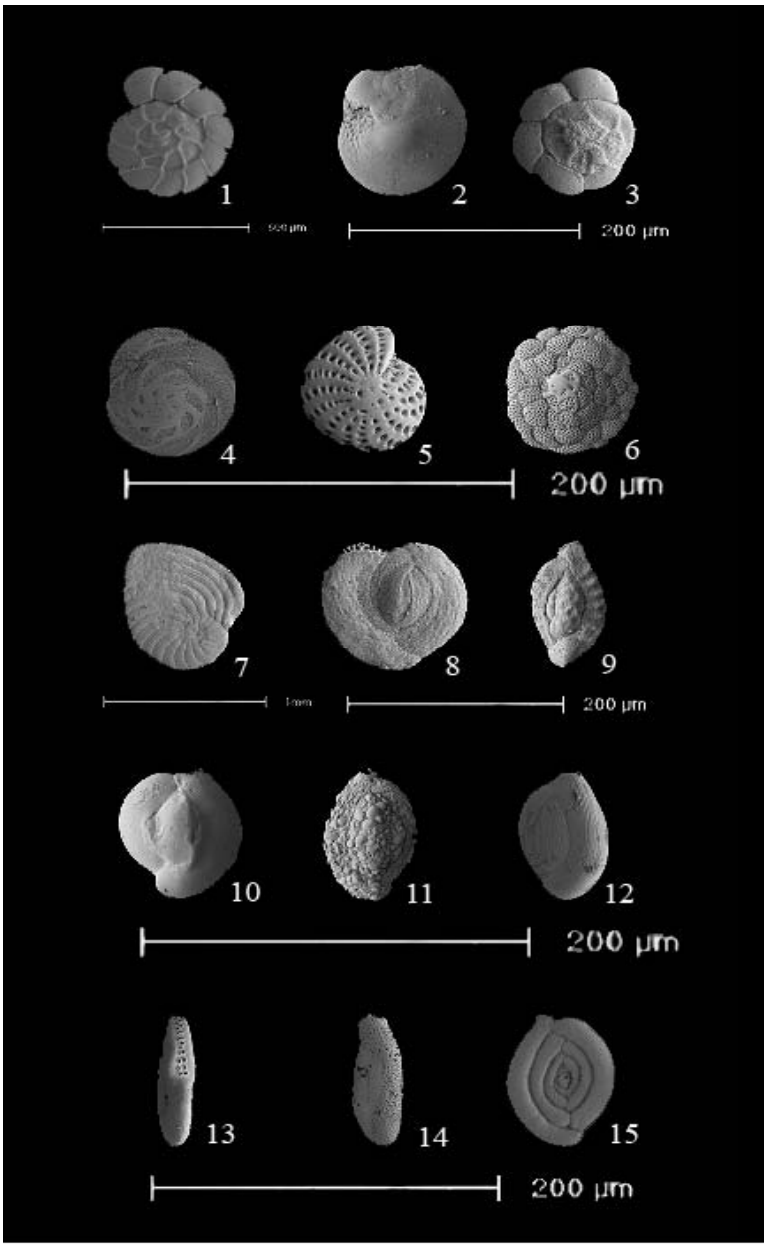


Figure 1: the position of Asalooye in Persian Gulf

Plate 1



1: ***Ammonia beccarii*** **2:** ***Amphistegina lobifera*** **3:** ***Ammonia tepida***
4: ***Rotalia trochidiformis*** **5:** ***Elphidium craticulatum*** **6:** ***Cymbaloporetta*** **sp.**
7: ***Peneroplis planatus*** **8:** ***Pseudohauerina*** **sp.** **9:** ***Pseudohauerinella dissidens***
10: ***Quinqueloculina seminulum*** **11:** ***Quinqueloculina agglutinans*** **12:** ***Triloculina inflata***
13*: Dendritina ambigua* **14:** ***Rupertianella rupertiana*** **15:** ***Spiroloculina depressa***