Foraminifera as a low-cost and effective monitoring tool for trace metal pollution in the Arabian Gulf?

Abduljamiu Amao and Michael Kaminski

KFUPM, College of Petroleum & Geosciences, Geosciences, Dhahran, Saudi Arabia (amao@kfupm.edu.sa)

This paper investigates the distribution and abundance of living benthic foraminifera and trace metals in the offshore bottom sediments of the Arabian Gulf, to find relationship (if any) between trace metals and foraminifera assemblages and identify key species that could be useful for future pollution assessment. Duplicate sediment samples were collected from thirty stations in an area covering over 25000 square kilometers in offshore northern Arabian Gulf using a Van Veen grab. Samples were analyzed for trace metal concentrations and benthic foraminifera. The average temperature and salinity recorded for the areas are 32.1 ± 0.8 °C and 40.5 ± 0.9 respectively. Turbidity was 1.4 ± 0.4, pH 8.1 ± 0.1 and D.O was 6.0 ± 0.3 mgl-1. The trace metal concentrations recorded were generally within the range of background concentration i.e. Al (6880.2 ± 2687.6), As (2.8 ± 2.8), Cd (0.03 ± 0.1), Co (4.5 ± 2.0), Cr (24.4 ± 9.6), Cu (8.6 ± 3.3), Fe (6503.7 ± 2066.6), Hg (0.04 ± 0.04), Li (12.1 ± 3.7), Mn (174.5 ± 76), Ni (52.1 ± 18.0), Pb (2.8 ± 0.9), V (14.9 ± 4.2), Zn (14.8 ± 6.3). The diversity was generally high for all the stations, while high dominance was recorded for two out of the 30 stations. A total of 271 living benthic foraminiferal species and subspecies were identified belonging to 66 genera, 37 families, 23 superfamilies and 6 orders. They were further grouped by dominant wall types i.e. hyaline (45%), porcelaneous taxa (42%), agglutinated (12%), while the spirillinid group which is often referred to as having an optically single crystal or a mosaic of few crystals has only 1% representation. The most abundant species include Quinqueloculina seminula (6.2%), Miliolinella subrotunda (5.1%), Elphidium neosimplex (4.9%), Asterorotalia dentata (4.9%), Triloculina tricarinata (4.3%), Cancris auricularis (2.7%), Spiroloculina sp. 2 (2.4%), Q. lamarckiana (2.4%), M. lutea (2%), and Hanzawaia sp. 1 (1.8%).

Based on PCA analysis, 77.37% of the variability in the dataset can be explained by the first two principal component axes. Thus, there is a strong correlation between benthic foraminiferal diversity indexes and trace metals measured in the sediment. Although, the use of foraminifera for pollution detection and monitoring is well established, only 5% or less are known to be cosmopolitan, many species are rare, and most are endemic. This study helps to establish a baseline dataset and identify endemic species adapted to extreme conditions within the Gulf.