Benthic foraminifera: an ecological approach for the environmental quality assessment of sediments in the Augusta harbour (Sicily, Italy)

Elena Romano, Luisa Bergamin, Maria Celia Magno, Antonella Ausili

ISPRA – Institute for the Environmental Protection and Research, , Via di Casalotti, 300 – 00166, Rome, Italy

Phone: +39-0661570437

E-mail: e.romano@icram.org

Introduction: An important harbour, including one of the largest Italian petrochemical poles in the southern area, is located on the Augusta bay (Eastern Sicily, Italy). Since the '50s the industrial activity has determined heavy consequences on terrestrial and marine environment. The environmental characterization of marine sediments in this area included the analysis of benthic foraminifera as integrative ecological approach. For their short life-cycle, abundance in sediments and high taxonomic diversity they have been widely used in recent times as environmental indicators (Nigam et al., 2006). In this study abundance, diversity and percentage of abnormal specimens were considered as potential indices of environmental quality and correlated with chemical and textural features of sediments in order to evaluate the ecological health of sediments in the Augusta harbour.

Methods: A total of 36 superficial sediment samples collected by van Veen grab were considered and analyzed for benthic foraminifera, trace elements (As, Cd, Cr, Cu, Fe, Hg, Ni, Pb, Zn), Polycyclic Aromatic Hydrocarbons (PAHs) and Polychlorobyphenyls (PCBs). The whole analytical methods are described in Romano et al. (2008). The Q-mode cluster analysis was applied to the results of faunal analysis in order to highlight groups of samples (foraminiferal facies) with similar response to environmental conditions.

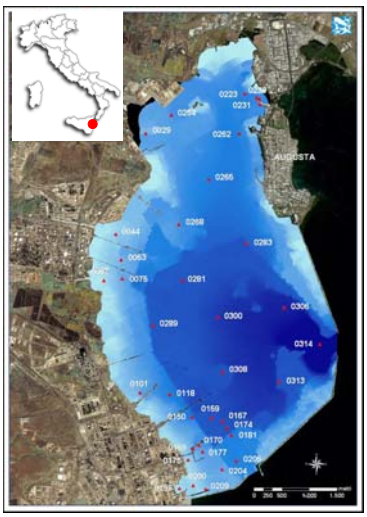

Fig. 1: Augusta harbour with sampling stations.

Results: The chemical results show high contamination of sediment mainly due to Hg, and secondly to PAHs and PCBs, with a decreasing concentration trend from the southern to the northern area. The study on foraminifera highlighted three main facies. The first one includes samples characterized by sandy sediments with high mud content and the lowest pollution degree located in the northern-central harbour. The assemblages show the highest abundance and diversity indices, within the normal range for marine coastal environments. Only 6% of samples show abnormal specimens (FAI index) exceeding the normal background. The second facies is represented by few samples very similar to the previous ones as regards grain-size, with considerable PAHs pollution, located close to the outflow of streams. They show the lowest diversity and abundance, while FAI index is constantly below the natural limits. The third facies is located in the southern sector; samples display the highest sand percentages and the highest pollution levels, especially for Hg, PAHs and PCBs. Particularly, Hg meanly exceeds two orders of magnitude the limit of Italian regulatory. The assemblages are abundant and diversified. Nevertheless, 20% of samples exceed the normal background for FAI index. Although a biometric study was not carried out, stunted assemblages were recognized only in this area.

Discussion: Considering the ecology of the prevailing species, it may be supposed that their distribution is mainly conditioned by grain-size and river inputs. Generally, foraminiferal abundance and diversity do not appear significantly influenced by the associated high pollution degree and let us suppose an adaptation to polluted sediments. Thus, these parameters may not be considered as pollution indices. Nevertheless, the highest FAI index, the presence of stunted assemblages and abundance of species recognized as "pollution tolerant" in the third facies highlight a considerable environmental stress referable to high pollution degree and lowered sediment quality due to the *in-situ* industrial activities in the southern area.

References: [1] Nigam et al. (2006) *Environ. Internat.* **32**:273-283; [2] Romano et al. (2008) *Mar. Poll. Bull.* **56**:439-457.