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Foraminiferal record of anthropogenic environmental changes in the northeastern Adriatic Sea (Panzano Bay, Gulf of Trieste, Italy)

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The northern Adriatic Sea is one of the world's largest modern epicontinental seas and a young marine ecosystem that has been subject to various natural and anthropogenic processes during the Holocene: marine transgression, regional climate fluctuations, urbanisation and pollution. The Gulf of Trieste, located in the northeastern part, presents the area of particular interest, as it is a shallow and sheltered embayment, prone to the accumulation of pollutants, populated for at least the last 2000 years and with recent anthropogenic pressure coming from several rivers, ports and industrial zones.
The aim of this multidisciplinary study is to provide a high-resolution record of these processes using benthic foraminiferal assemblages, geochemical proxies (trace metals, nutrients and pollutants), sedimentological (sedimentation rates) and time-averaging data (from dated mollusc shells). One core of 1.5 m length was taken at the sampling station Panzano Bay, northernmost part of the Gulf of Trieste, at the water depth of 12.5 m. The sedimentation rate is estimated to be 2.5 mm/year, based on 210Pb sediment dating, while dating of the molluscs shells revealed the age at the bottom of the core to be approximately 500 years. The core was sliced into smaller subsamples, and four sediment fractions of each subsample (63, 125, 250 and 500 μm) were analysed for standard properties of the foraminiferal community (faunal composition, absolute and relative abundances of species, biodiversity indices), in order to make comparison with relevant physical and geochemical properties of the sediment. The results concerning changes in foraminiferal species composition, their abundance and biodiversity, supported by statistical analyses (cluster analysis, NMDS, PCA), allow identification of three major foraminiferal associations:
1) 80-150 cm – the oldest association is dominated by opportunistic genera ans species, characteristic for unstable environments: Valvulineria sp. (25-50%), non-keeled elphidiids (23-39%), Ammonia tepida (5-10%) and Haynesina depressula (5-17%).
2) 25-80 cm – opportunistic species are still highly abundant, but there is the increase in abundances of epiphytic species (Adelosina laevigata, Quinqueloculina seminula, Miliolinella subrotunda).
3) 0-25 cm – the youngest association is characterised by the decrease in abundances of opportunistic species and relative higher precentages of epiphytic species: Eggereloides scabrus, A. laevigata, Q. seminula, M. subrotunda. Foraminiferal biodiversity is increasing from the oldest toward the youngest association.
The sediment throughout the core is composed of silty clay. Older sediment intervals (80-150, 25-80 cm) have higher concentrations of major (Fe, Al), minor (Mn, P) and trace elements (Hg, Cr, Cu, Ni, As, Li), compared to the uppermost sediment. The concentrations of Pb, Zn, P, TOC, N tot, PAH and PCB display the opposite trend and increase in the youngest sediment interval (0-25 cm).