Disponible en ligne sur
ScienceDirect
www.sciencedirect.com

Elsevier Masson France
EM|consulte
www.em-consulte.com/en

Revue de micropaléontologie

Revue de micropaléontologie 59 (2016) 19–32

Original article

Live and dead benthic foraminiferal assemblages from coastal environments of the Aegean Sea (Greece): Distribution and diversity

Assemblages vivants et morts de foraminifères benthiques des environnements côtiers de la mer Egée (Grèce) : distribution et diversité

Margarita D. Dimiza [a], Olga Koukousioura [a,b], Maria V. Triantaphyllou [a,*], Michael D. Dermitzakis [a]

[a] *National and Kapodistrian University of Athens, Faculty of Geology and Geoenvironment, Panepistimiopolis, 15784 Athens, Greece*
[b] *Aristotle University of Thessaloniki, Department of Geology, Thessaloníki, Greece*

Abstract

Benthic foraminiferal composition assemblages and their temporal changes, ecological indices and foraminiferal densities are used to compare three coastal environments with different physicogeographical features in the Aegean Sea (coastal environment of Avdira–Vistonikos Gulf and Kitros–Thermaikos Gulf and open lagoonal environment of Vravron–South Evoikos Gulf). Three main foraminiferal assemblages have been recognized: a) "Assemblage A"; high degree of similarity between living and dead foraminiferal species, dominated by *Ammonia beccarii*, *Elphidium* spp. and relatively abundant and diverse miliolids, b) "Assemblage B1"; intermediate degree of similarity between live and dead assemblages, characterized by highly-abundant and well-diversified foraminiferal assemblages including the algal symbiont bearing *Peneroplis pertusus* together with *Ammonia tepida* and several small epiphytic rotaliids and miliolids, and c) "Assemblage B2"; absence of living individuals, strongly dominated by the opportunistic species *A. tepida.* Our results suggest a good comparison between living and dead assemblages from different coastal environments in the Aegean Sea, however the prevailing environmental conditions (vegetation cover, hydrodynamics, fresh water influx) have a strong impact on the taphonomic processes.

Keywords: Benthic foraminifera; Coastal environments; Aegean Sea

Résumé

La composition en foraminifères benthiques, leur distribution temporelle, les indices écologiques et la densité sont utilisés pour comparer trois sites côtiers de mer Egée avec des caractéristiques physico-géographiques différentes. Ces sites sont les environnements côtiers des golfes d'Avdira–Vistonikos et de Kitros–Thermaikos et l'environnement lagunaire ouvert du golfe de Vravron–Sud Eubée. La zone côtière d'Avdira a révélé 38 espèces de foraminifères avec un degré élevé de similitude au cours des différentes périodes d'échantillonnage, indiquant des eaux marines peu profondes. Trois assemblages principaux de foraminifères ont été reconnus : a) « Assemblage A » ; haut degré de similitude entre les spécimens de foraminifères vivants et morts, dominé par *Ammonia beccarii*, *Elphidium* spp. et les miliolidés, relativement abondants et diversifiés, b) « Assemblage B » ; degré intermédiaire de similitude entre les foraminifères vivants et morts, caractérisé par une faune de foraminifères très abondante et bien diversifiée y compris le porteur d'algues symbiotiques *Peneroplis pertusus* avec *Ammonia tepida* et plusieurs petits rotaliidés et miliolidés épiphytes et c) « Assemblage C » ; absence d'individus vivants, fortement dominé par l'espèce opportuniste *A. tepida*. Nos résultats suggèrent que l'abondance et la variabilité de la composition en foraminifères dans les environnements côtiers étudiés de la mer Égée sont principalement contrôlés par l'interaction entre l'influence estuarienne et marine, affichant une composante géographique naturelle importante.

Mots clés : Foraminifères benthiques ; Environnements côtiers ; Mer Egée

* Corresponding author.
E-mail address: mtriant@geol.uoa.gr (M.V. Triantaphyllou).

http://dx.doi.org/10.1016/j.revmic.2015.10.002
0035-1598/

1. Introduction

Coastal areas represent very productive ecosystems and are undoubtedly affected mostly by environmental stress (Barnes and Hughes, 1999). Particularly, coastlines and coastal plains are highly dynamic areas due to their position between land–sea. These environments are characterized by high spatial and temporal variability related to episodic influence of high-energy (marine and fluvial) events. The subsequent instabilities affect their natural equilibrium resulting in a suite of changes in marine benthic communities (Barnes and Hughes, 1999). Consequently, coastal environments are favorable ecosystems for investigating the variations in species composition, diversity and ecological niche content and for defining the role of the environmental parameters in explaining these changes.

Foraminifera are typically a significant component of living meiobenthic communities in coastal environments (Moodley et al., 1998). The distributional studies of benthic foraminifera from such areas represent a significant source of information of the species variety and ecological tolerance, as well as of their temporal and spatial development. Furthermore, as eukaryotes, foraminifera behave like animals, responding directly to stimuli from their environment, whereas as unicellular organisms, they have short reproductive and life cycles that make their assemblages particularly sensitive to environmental fluctuations. Hence, changes in benthic foraminiferal abundance, species composition (Debenay et al., 2000) and variation in test morphology (Boltovskoy et al., 1991) might provide evidence of environmental factor fluctuations such as temperature, salinity, food availability, substrate, dissolved oxygen and water quality. Over the last decades, benthic foraminiferal assemblages have been widely used as sensitive bioindicators to determine the ecosystem conditions, providing a reliable measure of environmental health and balance (Alve, 1995; Yanko et al., 1999; Schafer, 2000; Armynot du Châtelet and Debenay, 2010; Frontalini and Coccioni, 2011; Schönfeld et al., 2012; Dimiza et al., 2016).

The present study investigates living and dead foraminiferal assemblages from three coastal environments in the Aegean Sea to acquaint full knowledge of species composition in the intertidal zone, identify the impact of taphonomical processes and investigate if the use of foraminiferal thanatocoenoses in paleoenvironmental reconstruction of coastal plains is trustfully reflecting the original faunal composition.

2. Material and methods

2.1. Study area

The Aegean Sea is located in the northeastern region of the Mediterranean, an area that is generally characterized by low precipitation and elevated salinities associated with high evaporation rates. However, several rivers discharge into the Aegean Sea, mostly from the north Hellenic coast and the eastern Turkish coastline (Fig. 1). The annual maximum sea surface temperature (SST) (~24 °C) occurs around August/September (warm period during late spring-early autumn); minimum SSTs (~13 °C) occur in February/March (cold period during winter-early spring), (Poulos et al., 1997; Triantaphyllou et al., 2004). Sea surface salinity (SSS) values vary seasonally, ranging from less than 31.0 to more than 39.0. Salinity and temperature of the Aegean surface waters oscillate seasonally and increase gradually from north to south.

The studied sites represent important wetlands, protected by the international Ramsar convention, therefore affected by minimum anthropogenic influence. They represent different physicogeographical features within the Aegean Sea area, and include the coastal environments of Avdira–Vistonikos Gulf and Kitros–Thermaikos Gulf (northern Aegean Sea) and the open lagoonal environment of Vravron–South Evoikos Gulf (southwestern Aegean Sea) (Fig. 1). The sampling areas are featured by shallow water depths, ranging between 10 and 100 cm, and a microtidal range of about 10–30 cm. The Holocene sediment sequence in the associated coastal plains displays alternations mostly composed of clays, sands and sandy silts (Koukousioura et al., 2012); evidence on their paleonvironmental evolution is based on the succession of foraminiferal assemblages during the last 7500 years (Koukousioura et al., 2012).

Vistonikos Gulf is a small, shallow water area in the Thracian Sea/northern Aegean region. The gulf hydrodynamic and environmental characteristics are largely controlled by the flows from Lake Vistonis (40 km^2) through natural and artificial channels (Fig. 1). The estuarine area in between Vistonikos coast and the Lake Vistonis corresponds to Lafri–Lafrouda and Porto Lagos lagoons (Fig. 1). The area is recognised as a Wetland of International Importance by the Ramsar Convention (1971) and as a Special Protection Area is included in the network Natura 2000 of the European Union (Dafis et al., 1997). Avdira coast is located at the coastal zone on the western edge of Vistonikos Gulf, at the east side of River Nestos mouth.

Thermaikos Gulf is a semi-enclosed, shallow basin in the northwestern part of the Aegean Sea. The environmental setting of the area is defined by the incidence of three major rivers (Axios, Aliakmon and Pinios) flowing to the shelf (Fig. 1). During wet period (winter and spring), the freshwater intrusion can extend southwards sealing a major part of Thermaikos's surface waters; whereas the freshwater layer is confined close to the river outlet during low water influx (Hyder et al., 2002). The Alykes Kitros lagoonis protected by the Ramsar Convention (1971). Kitros coast is located at the western side of Thermaikos Gulf at the northern margin of the Katerini–Pieria basin (Fig. 1).

South Evoikos Gulf represents a closed embayment located between the Attica peninsula and Evia Island in the southwestern Aegean Sea. The largest river flowing into the northern part of the gulf is Asopos (Fig. 1), whereas other small rivers, streams and some coastal and underwater springs discharge into the basin during the winter and spring seasons. Amongst them, the small Erasinos Stream discharges into the Evoikos Gulf, flowing through Vravron coastal–estuarine plain (Fig. 1). Vravron bay/open lagoon is included in the network Natura 2000 European Community Network.