

LATE MIOCENE BRYOZOAN ASSEMBLAGES FROM GAVDOS ISLAND (SOUTH GREECE) AND THEIR PALEOECOLOGICAL SIGNIFICANCE

Tsaparas N., Drinia H., Antonarakou A., Marcopoulou-Diakantoni A., Dermitzakis M.

National and Kapodistrian University of Athens, Faculty of Geology and Geoenvironment,
Panepistimiopolis 157 84, Athens Greece, ntsapar@geol.uoa.gr

In Gavdos Island, southern Greece, the outcrops from Middle to early Late Miocene are dated by planktonic foraminifera. One of the most important outcrops is Bo section situated along the northwest coast of the island (Fig. 1). It is 25 m thick and is mainly composed of marly sediments in the lower part and remnants of a reefal buildup, which is developed as light grey cavernous marly limestones alternating with clayey-sandy deposits and may be considered as a patch reef, in the upper part (Fig. 1). The lower part of Bo section is very rich in various benthic fauna (sponge spicules, bryozoans, molluscs, *Balanus* sp., otoliths; Tsaparas, 2005).

The main purpose of this study is to assess paleoenvironmental variations occurring through the marine sedimentary succession of Bo section, using an analysis of the distribution of bryozoan colonial morphotypes. Bryozoans were found in nine of the eleven samples collected in the studied section (Table I). They belong to 19 species which have been divided into six different colonial (or zoarial) growth forms.

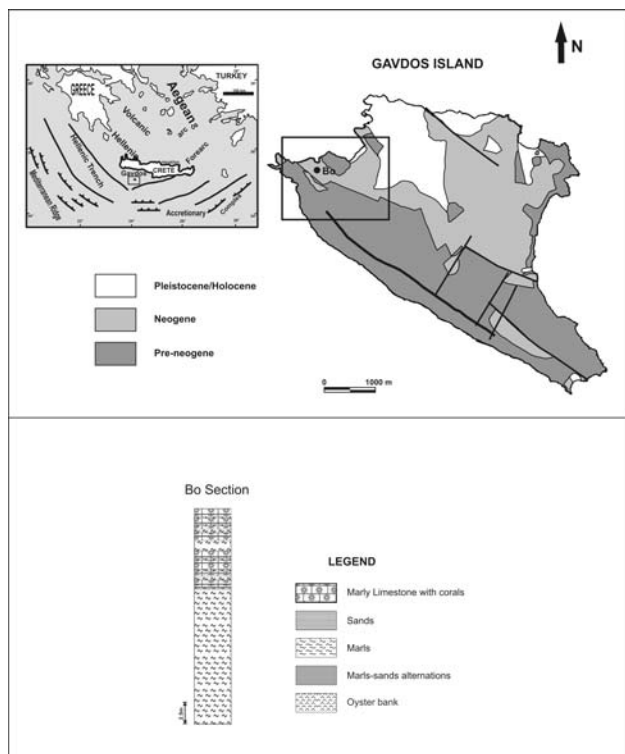


Fig. 1. Simplified geological map of Gavdos Island. Lithostratigraphical column of the studied section.

Material and Methods

Most of the material used in this study was collected by the senior author during field excursions in 1996, 1997, and 1999. Eleven samples were collected from the studied section. For each sample, 500 g of dry sediment was weighed, washed and sieved on a column of six sieves with diminishing mesh size. Bryozoan remains were found only in the four coarser sieves.

Table I:

Samples	M1	M2	M3	M4	M5	M6	M7	M8	M10	M11	M12
Stratigraphic level (m)	0,5	2,5	4,7	7	9,8	12,25	14,7	16,6	17,7	19,15	24,7
Bryozoan species											
<i>Annectocyma major</i>	*								*	*	
<i>Crisia denticulata</i>	*	*				*	*	*	*	*	*
<i>Crisia fistulosa</i>	*									*	*
<i>Crisia eburnea</i>	*									*	
<i>Crisia elongata</i>	*					*	*	*	*	*	*
<i>Crisia sp.</i>		*	*								
<i>Tervia irregularis</i>	*					*	*	*	*	*	
<i>Scrupocellaria elliptica</i>	*		*				*	*	*	*	*
<i>Scrupocellaria sp.</i>	*										
<i>Biflustra savarti</i>	*										
<i>Chaperia annulus</i>	*										
<i>Cupuladria canariensis</i>	*								*		
<i>Cellaria fistulosa</i>	*										
<i>Exidmonea atlantica</i>	*					*	*		*	*	
<i>Lichenopora mediterranea</i>						*			*	*	
<i>Lichenopora hispida</i>											
<i>Porina coronata</i>							*				
<i>Turbicellepora laxesinuosa</i>										*	
<i>Crassimarginatella macrostoma</i>	*										
<i>Cribrilina punctata</i>							*				

Results

In the studied section, 6 species (*Annectonyma major*, *Biflustra savarti*, *Chaperia annulus*, *Lichenopora mediterranea*, *L. hispida*, *Crassimarginatella macrostoma*, *Cribrilina punctata*) belong to membraniporiform colonies which is an encrusting unilaminar morphotype attached by cementation on many hard substrates (mostly bivalve shells and other calcareous fragments of organisms). Only one celledoriform species (*Turbicellepora laxesinuosa*), in one sample, has been found in the studied section. According to Smith and Nelson (1994), the poor preservation of celledoriform bryozoans which are sensitive to abrasion, indicates high-energy conditions.

One vincularriform species (*Tervia irregularis*) has been identified in 6 samples. The narrow branches of the nonarticulate colony are adapted for life in deep or sheltered waters where wave action is absent and currents scarcely active. Therefore, this group

typifies growth in quiet waters. In particular *T. irregularis* is considered as a deep stenobathic species (Rosso and Di Geronimo 1998).

A free-living lunulitiform species (*Cupuladria canariensis*) has been found in only two samples. According to their present-day occurrence, lunulitiform bryozoans are frequent in sandy bottoms of deltaic environments within the circumtropical area. The rare occurrence of this morphotype in our record is probably due to the absence of the sandy bottoms preferred by this zoarial form. Another factor contributing to the paucity of lunulitiform colonies may be dissolution of these characteristically aragonitic bryozoans.

Cellariiforms are well represented in the section under study. Nine species (*Crisia denticulata*, *C. fistulosa*, *C. eburnean*, *C. elongata*, *Crisia sp.*, *Scrupocellaria elliptica*, *S. sp.*, *Cellaria fistulosa*, *Exidmonea atlantica*) have been determined. These erect, articulated cellariiforms live at various depths attached on different substrates (loose and solid). According to Lagaij and Gautier (1965), Schopf (1969) and Reguant et al. (1985), this is probably the colonial morphotype best adapted to regions of high sedimentation rates.

One species (*Porina coronata*), found in one sample, belongs to adeoniform zoarial form. This erect, rigid morphotype lives at moderate depths on various solid substrates.

Discussion

In Bo section, the bryozoan zoarial forms are dominated by cellariiform i.e. erect, flexible zoarium. This assemblage is commonly found in sandy, shallow marine environments with vigorous water motion. The ratio of erect forms versus encrusting forms is closely related to sedimentation rate. According to Lagaij and Gautier (1965), the cellariiform zoarial type is the least sensitive to high sedimentation rates and its occurrence to greater proportions could possibly be linked to an increase in terrigenous supply. The complete absence of membraniporiform colony remains in three samples, where erect (mostly cellariiform) morphotypes predominate, is interpreted as resulting from an accumulation-probably in very shallow waters- of the disarticulated segments of cellariiform colonies, easily transported over long distances (Poluzzi et al. 1991, 1997).

The constant occurrence of vinculariform morphotype in almost all the studied samples indicates intermediate depths (Moissette 2000). This is further supported by the nearly absence of celleporiform (present in only one sample) which is absent to very rare in deep habitats (Gordon 1987; Moissette and Spjeldhaes 1995; Rosso and Di Geronimo 1998).

Although found deeper, the cellariiform morphotype is abundant at moderate depths but can also predominate in shallow waters (Lagaij and Gautier 1965; Schopf 1969). It is confined to the warm waters of the tropics and subtropics, yet it is able to withstand seasonal changes in temperature.

Conclusions

The dominance of the erect, flexible bryozoan colonies in the early Tortonian Bo section suggests an unstable sedimentary bottom of moderate depths, with almost continuous arrival of fine detritic sediments.

Acknowledgements

The project is co-funded by the European Social Fund and National Resources – (EPEAEK II) PYTHAGORAS

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