Dachstein-type loferitic facies in the Upper Triassic-Lower Jurassic carbonate platform of the Eastern Greece Zone.

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This study aimed at the careful sedimentological analysis of the shallow-water carbonate sediments (Dachstein-type loferitic facies of "Pantokrator" Formation) developed during the Upper Triassic-Lower Jurassic times at the carbonate platform (referred to in this work as Pelagonian palaeoplatform) that geotectonically belongs to the zone of the internal Hellenides known as Eastern Greece. The neritic carbonates (limestones, dolomitic limestones) have been studied in order to determine their depositional environment and investigate their cyclic pattern.

The sedimentary facies of the chosen platform sections – which are located in the SW part of the Argolis peninsula (Didymi Mountains, Karnezeika area) as well as, in the SE part of the Corinthia (Korfos and Sofiko areas) and in the area of central Greece opposite Chalkis (Euboea) – have been studied in detail (Kostopoulou 2018). Loferitic facies have been described in the Didymi (Pomoni-Papaioannou, 2008) and Karnezeika (Varti-Mataranga and Matarangas, 1991) areas.

Eleven vertical profiles were systematically sampled for sedimentological analysis, using stained thin sections (Kostopoulou, 2018). The carbonate classification follows the schemes of Dunham (1962) and Folk (1959, 1962). Microfacies analysis is based on Wilson (1975) and Flügel (1982, 2004).

Macroscopic observations and microscopic characteristics lead to the definition of thirty eight carbonate microfacies and four facies zones (depositional environments). The described in detail microfacies (microfacies types/MF) can be classified into the following three facies associations that correspond, respectively, to the members C, B and A of the Fischer's (1964) typical Lofer cyclothem.

The lagoonal-shallow subtidal facies association generally consists of wackestones, packstones, packstones/grainstones and boundstones with diverse marine fauna and flora (e.g. megalodonts, dacycladacean algae, involutinids) (Fig. 1c). Peloids, microcoprolites, oncoids, aggregate grains, cortoids, small ooids and intraclasts are included in the observed non-skeletal particles.

The intertidal facies association mainly comprises of microbial (algal) laminated bindstones and fenestral algal bindstones/algal mat loferites (Fig. 1b). They are characterized by planar or crinkled well-developed laminations, abundant fenestrae with geopetal filling and a variety of desiccation structures. Pellet loferites also commonly occur and stromatolite intrabreccia are subordinately observed.

The supratidal-pedogenic facies association is represented by microfacies containing abundant subaerial diagenesis-related features, which reflect emersion events of different duration and subsequent weak or stronger early meteoric modification. Pisoids, circumgranular cracks, meniscus and microstalactitic cements, alveolar-septal structure, black pebbles, and rhizolite-like structures are included among the recognized diagenetic micromorphological characters (Fig. 1a).

The facies zones (FZ) correspond to lagoonal, intertidal, supratidal and emerged tidal/coastal areas of the platform internal sector. Very shallow areas with little circulation that periodically were flooded by marine waters constituted the intertidal and supratidal areas. They were covered by microbial mats and their deposits commonly were subaerially exposed and modified. Adjacent to them, shallow lagoons were developed up to the backreef/marginal sector of the paleoplatform.

Micropalaeontological analysis of the loferitic facies discussed in this study has revealed the presence of dasycladacean green algae and benthic foraminifers (e.g. involutinids, duostominids). Mollusc shell-fragments (gastropods and bivalves), ostracods, porostromate algae and thaumatoporellids are also present. In many cases, Megalodon-bearing subtidal beds (floatstones) can be observed along exposed sections. A Late Triassic (Norian-Rhaetian) age for the studied sediments can be accepted. Particularly, as regards the organism Thaumatoporella, its presence is dominant and exclusive in subtidal layers lacking benthic foraminifers, dasycladaceans and megalodontids. A Late Triassic-?Lower Jurassic age is presumable for these distinct loferitic successions, on the basis of the fossil assemblages distribution across the T/J boundary (e.g. Barattolo & Romano 2005).

In the investigated carbonate successions the detected basic facies pattern and meter-scale (lofer) cyclicity closely resemble that described in the type locality of the Dachstein Limestone Formation (Northern Calcareous Alps). The observed cycles usually deviate from the ideal symmetrical lofer cycle (sensu Haas 1991). Although various stacking patterns are recognized, including symmetric and asymmetric incomplete cycles, the deepening-upward facies arrangement is prevalent. In the Didymi area, cyclothems showing shallowing-upward trend have been also distinguished (Pomoni-Papaioannou 2008).

The cycles are generally bounded by subaerial exposure-related discontinuity surfaces that point to changes and interruptions in sedimentation. In several cases, the vadose meteoric diagenetic features (e.g. microkarstic features) overprint the subtidal strata below the subaerial disconformities, implying periodic sea-level drop and supporting allocyclic control of the cyclicity (i.e. eustatic control) in the study area. Nevertheless, the contribution of autocyclic processes and/or tectonic motions cannot be excluded.

In the examinated sections the cycles display common basic characteristics. However, significant differences concerning the (micro)facies of their subtidal members are noted. Oncoidal microfacies – corresponding to the oncoidal facies of Dachstein limestones (oncoidal Dachstein Limestone) – were developed in the more external lagoonal area, near the backreef/marginal zone of the platform. In contrast, rich in bioclasts and peloids subtidal microfacies were formed in the internal lagoonal area, far from the platform margin.

Furthermore, syndepositional tensional features (e.g. fractures, small faults, sedimentary dykes, internal/synsedimentary breccias) overprint the topmost Upper Triassic loferitic successions of the "Pantokrator" Formation (Karnezeika area). They are regarded as the result of the synsedimentary extensional tectonic activity that took place at the Triassic/Jurassic boundary.

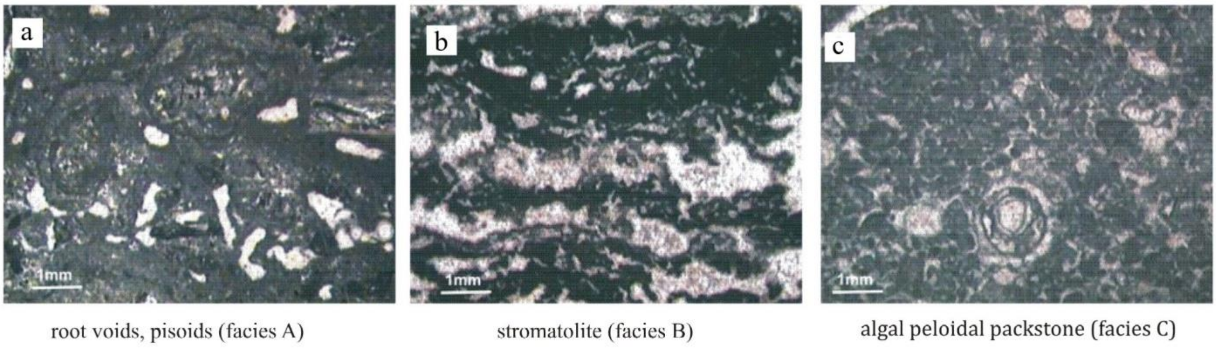

Fig. 1: Characteristic microfacies recognized in the studied sections.

Finally, the comparison between the investigated lofer cyclothems and those reported from distant and different palaeogeographic segments of the western Neotethys realm (e.g. Northern Calcareous Alps, Transdanubian Range, Southern Alps, Dinarides) reveals conspicuous similarities in rhythmic sedimentation, cycle thickness, litho- and biofacies. The considerable analogies support eustasy, as the prevailing lofer cycle-forming mechanism, although the influence of other factors (e.g. autocyclic processes) cannot be ruled out (Haas *et al.* 2009).

References

Barattolo, F., Romano, R. 2005. Shallow carbonate platform bioevents during the Upper Triassic-Lower Jurassic: an evolutive interpretation. Bolletino Societa Geologica Italiana, 124, 123-142.

Dunham, R.J. 1962. Classification of carbonate rocks according to depositional texture. American Association Petroleum Geologists, Memoir, 1, 108-121.

Fischer, A.G. 1964. The Lofer cyclothems of the Alpine Triassic, in: Merriam, D.F. (Ed.) Symposium on cyclic sedimentation. Kansas Geological Survey Bulletin 169, 107-149.

Flügel, E. 1982. Microfacies Analysis of Limestones. Springer.

Flügel, E. 2004. Microfacies of carbonate rocks: Analysis, interpretation and application. Springer.

Folk, R.L. 1959. Practical petrographic classification of limestones. American Association Petroleum Geologists Bulletin, 43, 1-38.

Folk, R.L.1962. Spectral subdivision of limestone types. American Association Petroleum Geologists, Memoir, 1, 62–84

Haas, J., 1991. A basic model for lofer cycles, in: Einsele, G., Ricken, W., Seilacher, A. (Eds.), Cycles and Events in Stratigraphy, 722–732.

Haas, J., Pomoni-Papaioannou, F., Kostopoulou, V. 2009. Comparison of the Late Triassic carbonate platform evolution and Lofer cyclicity in the Transdanubian Range, Hungary and Pelagonian Zone, Greece. Central European Geology, 52, 153–184.

Kostopoulou, V. 2018. Lofer cycles in the Upper Triassic-Lower Jurassic carbonate platform of the Eastern Greece zone. Ph.D. Thesis, National & Kapodistrian University of Athens, Athens, 362 p.

Pomoni-Papaioannou, F. 2008. Facies analysis of Lofer cycles (Upper Triassic), in the Argolis Peninsula (Greece). Sedimentary Geology, 208, 79-87.

Varti-Mataranga, M., Matarangas, D. 1991. Depositional facies and diagenetic phenomena in "Pantokrator Limestones" of Argolis Peninsula (Tasoulaika-Karnazaiika area). Bulletin Geological Society Greece, XXXV/I, 339–354.

Wilson, J.L. 1975. Carbonate facies in geologic history. Springer.