Integrated palaeoenvironmental reconstruction of a Lower Pleistocene section (Sousaki basin, Northeastern Corinth Gulf): using fuzzy logic to decipher long term palaeoenvironmental changes.

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Palaeoecological analyses are important tools for the reconstruction of palaeoenvironmental changes. In this paper microfossil assemblages (ostracodes and palynomorphs) of Lower Pleistocene age, are used to reconstruct the biological and physical conditions of the palaeoenvironment during a time interval when palaeoclimatic and palaeoecological data from the Balkan Peninsula are scarce. Lower Pleistocene is an epoch when major changes in the palaeoclimate occurred (commencement of the Quaternary glaciations) affecting the palaeoenvironments worldwide. The studied section, geotectonically belongs to the Northeastern Corinth gulf, and lies near the town Ag. Theodoroi, west of Athens, consisting of alterations of marls and marly limestones with intercalations of organic rich sediments and gypsum beds. Detailed logging of the section was carried out and 76 samples were collected for micropalaeontological analysis. Additionally, 22 samples were studied for their palynological content. The results were statistically processed using standard palaeoecological methods (percentage abundance diagrams, biodiversity indices and multivariate analysis). Our interpretation was further supported by fuzzy logic methods, in order to remove subjectivity from the biostratigraphical data providing a higher degree of detail. Despite this though, their use in geology remains limited until now. In our case study, fuzzy sets examine the data from a more general perspective and contain natural variations that are present in species abundance gradients between evolving environments.

The lithological and micropalaeontological analysis revealed a brackish lagoonal environment dominated by the typical brackish ostracode species Cyprideis torosa. The studied sequence shows cyclically changing subenvironments fluctuating from the outer to the inner zone of a lagoon as imposed by the alternating occurrence of the ostracode families Tyrrhenocytheridae and Candonidae and the foraminifera species A. tepida. The palynological analysis revealed a vegetation of Mediterranean type with altitudinal zonation and a more or less stable climate with minor fluctuations in aridity. These fluctuations correspond to the zonation of the palaeoenvironment suggesting that it is climatically controlled. The combination, for the first time, of typical micropalaeontological analyses and fuzzy modeling results enabled the generation of a high-resolution palaeoenvironmental reconstruction model and eventually allowed the determination of the main factors that affected the evolution of the palaeoenvironment in the wider Sousaki basin during the Lower Pleistocene.