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INTEGRATED PALEOECOLOGICAL APPROACH OF THE PLIOCENE AT HAROKOPIO AND GLYKOVRYSI, S PELOPONNESE, GREECE - IMPLICATIONS ON THE DEPOSITIONAL ENVIRONMENT BASED ON FORAMINIFERS, MOLLUSCS, OSTRACODES, AND FISH ASSEMBLAGES

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Recent investigations of Neogene strata of the southern Peloponnese (Greece, Aegean Sea) yielded new data concerning the biostratigraphical and paleoecological interpretation of the sedimentary evolution of this part of the eastern Mediterranean. This is of major interest in the interpretation of the developing Mediterranean and Paratethys basins and the transformation of oceanic to sea conditions in the former Tethys. The intense tectonic activity of the Aegean arc affected the sedimentary basins, especially those of Pliocene age.

We present new information on fossil assemblages from two localities of the southern Peleponnese. The Lower Pliocene (Zanclean) coastal section of Harokopio is situated in the western part of the Peloponnese, SW of Kalamata. It is mainly composed of fine grained clays and silts. Glykovrysi, a section of Late Pliocene (Gelasian) age, is exposed along a road cut in the SE part of the Peloponnese. The fossils have been sampled from fine to medium coarse grained sands, containing glauconite.

Mollusc, ostracode, echinoid, and fish associations of Pliocene age from Greece have been only sporadically reported up to now. Although foraminifer faunas were studied in greater detail, most paleontological studies deal with biostratigraphical and systematical topics. Our research aims at a characterisation of the paleoecological conditions and the depositional environment of the studied localities.

Although the localities are different in age and sedimentology, there are no marked differences in the composition of the foraminiferal associations. They are dominated by benthic forms, such as *Ammonia*, *Elphidium*, *Textularia*, and *Quinqueloculina*. The textulariids and many of the *Elphidium* specimens have been grown remarkably bigger at Glykovrysi. Rare planctic *Globigerinoides* occur in both localities. The composition of the foraminifer fauna suggests a water depth of not more than 70 m.

This paleobathymetric interpretation is supported by the associated mollusc faunas. Gastropods are represented by soft substrate specialists like *Turritella*, *Aporrhais*, buccinids and naticids. At Glykovrysi, they are accompanied by hard ground forms like *Bolma*, *Diodora*, and different trochids.

The bivalve association of Harokopio, consisting of more than 60 species, is highly divers. It is dominated by shallow burrowing infaunal taxa like *Circomphalus*, *Venus*, *Acanthocardia*, and *Pelecyora*. Deeply burrowing forms, such as *Panopaea* and *Lutraria* are also abundant. There is some evidence for hardgrounds by the rare occurrence of byssate arcids. Several species are indicative of a subtropical climate and were driven out of the Mediterranean or became extinct during the Pliocene cooling. *Dosinia orbicularis, Noetiella rollei, Paphia vetula, Pelecyora brocchii, P. gigas,* and also the big gastropod *Strombus coronatus* belong to this group of molluscs.

At Glykovrysi, bivalves are represented by infaunal and epifaunal taxa. The infauna comprises mainly shallow burrowing forms (*Circomphalus*, *Glycymeris*, *Venus*, *Acanthocardia*). The epifauna consists of byssate Arcidae and Pectinidae and cementing Chamidae. The bivalve fauna of Glykovrysi is rather divers and more than 45 species are

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identified. In contrast to Harokopio, these species survived the Pliocene cooling and most taxa are known from the Pliocene or Holocene of the Mediterranean.

The ehinoids of Glykovrysi are of major interest. The coarse grained fraction at this locality is frequently inhabited by *Echinolampas*, while *Echinocardium* and *Schizaster* occur in layers of fine sands.

Ostracodes are rather diverse in both localities. However, more taxa are present in Glykovrysi. Characteristic faunal elements include species of *Aurila*, *Candona*, *Cyprideis*, *Cyprina*, and *Tyrrhenocythere*, among others. Most of the taxa recorded are euryhaline and indicate not too deep marine environments for both localities.

The fish fauna of the studied sections is represented only by few selachian teeth and abundant teleostean otoliths. Selachian remains of two species were recovered from the locality of Harakopio. The first species is represented by a single tooth and fin spine of the benthopelagic and euryhaline cownose ray *Rhinoptera*. Modern cownose rays inhabit coastal to deep, warm-temperate to tropical waters, but migrate into more temperate waters during summer. Today, cownose rays are absent from the Mediterranean. This is the first record of *Rhinoptera* from the Pliocene of the eastern Mediterranean.

The other selachian is represented by a single tooth of a butterfly ray (*Gymnura* sp.), which is the second Pliocene record of this batoid. *Gymnura* is a typical demersal and marine ray of tropical and subtropical marine environments.

The diversity and taxonomic composition of teleosts based on otoliths is very similar at both localities. Most common are otoliths of euryhaline and eurythermal gobies (e.g., *Acentrogobius* sp., *Gobius* sp.). Other taxa belong to gadids (e.g., *Micromesistius* sp.), myctophids (e.g., *Diapus* sp.), ophioids (e.g., *Ophiodon* sp.). Surprisingly, no remains of *Bregmaceros* spp. were recovered. Modern gobies are common in the Mediterranean and are represented by 58 species belonging to 25 genera. Generally, they are interpreted as possible relict forms of the Tethys. Unfortunately, the systematics and taxonomy of gobies is far from being resolved and the otolithe morphology of most modern forms is still unknown. Therefore, it is not possible to identify potential endemic patterns or faunal exchanges between the eastern Mediterranean basins and the Paratethys.

EMANZIPATION VON DER UMWELT: PHÄNOTYPISCHE PLASTIZITÄT UNIONOIDER MUSCHELN DES MALAWISEES

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Die Süßwassermuscheln der Ordnung Unionoida sind für ihre sehr hohe intraspezifische morphologische Variabilität bekannt. Diese Variabilität wird im Zusammenhang mit einem hohen Maß an phänotypischer Plastizität als Anpassung an die zeitlich und räumlich sehr variablen Umweltbedingungen in Süßwasserökosystemen gesehen. Die Zusammenhänge zwischen der Variabilität speziell der Schalenmorphologie der Muscheln und ihrer Umwelt sind schon seit über 100 Jahren bekannt. So sind viele Arten unionoider Muscheln im Oberlauf eines Flusses wesentlich stromlinienförmiger gestaltet als ihre Artgenossen im Unterlauf des gleichen Flusses. Diesem „Law of Stream Distribution“ folgen im Sinne älterer Konzepte nur primitive Muscheln, während fortschrittliche Muscheln keine geregelten Änderungen der Schalenmorphologie zeigen. Mit dem hier entwickelten Konzept lassen sich unter Nutzung moderner morphometrischer Verfahren die evolutionsbiologischen Konsequenzen des „Law of Stream Distribution“ besser verstehen und ermöglichen dessen

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