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Original article

The late Messinian Lago-Mare episode in the Mediterranean Basin: Preliminary report on the occurrence of Paratethyan ostracod fauna from central Crete (Greece)

Le Lago Mare du Messinien supérieur dans le bassin méditerranéen : première découverte d'une faune d'ostracodes paratéthysiens dans la région centrale de l'île de Crète

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Abstract

In the Crete Island, late Messinian Lago-Mare facies are not well known. At present, the occurrence in Crete of the uppermost Messinian post evaporitic deposits is a matter of debate. According to several authors, the well-known late Messinian Lago-Mare facies does not occur in Crete. In this paper the preliminary results obtained from the biostratigraphical analysis of some sections sampled in the Messarà Plain will be shown. Nearby Faneromeni and Ano Akria villages, the Miocene/Pliocene boundary is well exposed. There, gypsum-bearing clay, laminated microcrystalline gypsum and gypsum-rudites characterize the evaporitic deposits of the Messinian stage. In these areas, above the Messinian evaporite, post-evaporitic fine-laminated polychrome clays, with intercalations of sandstones and conglomerates, have been found. In both the Faneromeni and Ano Akria area, the Pliocene grey clays and conglomerates rest unconformably on the uppermost Messinian post-evaporitic deposits. A 20 cm-spaced sampling has been performed in both the sections, for more than 100 samples collected. The results of the micropaleontological analysis performed on the Faneromeni and Ano Akria sections point to the occurrence of ostracod assemblages containing: *Loxocauda limata* (Schneider in Agalarova et al.), *Loxocauda* sp., *Cytherura pyrama* Schneider, *Cyprideis anlavauxensis* Carbonnel, *Cyprideis agrigentina* Decima, *Amnicythere palimpsesta* (Livental), *Amnicythere propinqua* (Livental), *Amnicythere accicularia* (Olteanu), *Amnicythere costata* (Olteanu), *Amnicythere multituberculata* (Livental), *Amnicythere* sp. D (Miculan in Bassetti et al.), *Amnicythere* sp. 2 Gliozzi and Grossi, *Amnicythere* sp., *Euxinocythere (Maeotocythere) praebaquana* (Livental in Agalarova et al.), Mediocytherideini indet., *Pontoniella pontica* (Agalarova), *Camptocypria* sp. 1 Gliozzi and Grossi, *Caspiocypris* sp., *Zalanyiella venusta* (Zalanyi), *Tyrrhenocythere* sp., *Loxoconcha rhombovalis* Pokorny, *Loxoconcha eichwaldi* Livental, *Loxoconcha* sp. A (Miculan in Bassetti et al.), *Loxocorniculina djafarovi* (Schneider in Suzin). In the analysed samples, reworked planktonic foraminifers and well-preserved charophyte gyrogonites have been also found. The ostracod assemblages found in the Messarà Plain belong to the *Loxocorniculina djafarovi* Zone (sensu Carbonnel, 1978), which characterizes the uppermost Messinian deposits of the whole Mediterranean Basin. At that time, the well-known Lago-Mare biofacies was also widespread on the Crete Island. The presence of Paratethyan ostracods in the post-evaporitic Messinian deposits of both Faneromeni and Ano Akria sections suggests that in the Crete Island the latest Messinian sedimentation took place in brackish water palaeoenvironments.

Résumé

Dans l'île de Crète, les faciès du Lago Mare du Messinien supérieur ne sont pas bien connus. Actuellement, la présence dans l'Île de Crète des dépôts post-évaporitiques du Messinien supérieur est une question qui fait débat. Dans ce travail, on présente les résultats préliminaires des analyses biostratigraphiques réalisées sur des échantillons prélevés dans des affleurements de la Plaine de Messarà. Près de Faneromeni et Ano Akria, la limite Miocène/Pliocène est bien observable. Ici, les dépôts évaporitiques du Messinien sont caractérisés par des argiles contenant du

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gypse, du gypse microcristallin laminé et des gypsorudites. Dans ces zones, on a trouvé au-dessus des évaporites du Messinien des argiles polychromes finement laminées. Les argiles grises et les conglomérats du Pliocène se trouvent discordants sur les dépôts post-évaporitiques du Messinien supérieur à Faneromeni comme à Ano Akria. Dans les deux coupes, l'échantillonnage a été réalisé tous les 20 cm (total de 100 échantillons). Les résultats des analyses micropaléontologiques montrent la présence des ostracodes suivants : *Loxocauda limata* (Schneider in Agalarova et al.), *Loxocauda* sp., *Cytherura pyrama* Schneider, *Cyprideis anlavauxensis* Carbonnel, *Cyprideis agrigentina* Decima, *Amnicythere palimpsesta* (Livental), *Amnicythere propinqua* (Livental), *Amnicythere accicularia* (Olteanu), *Amnicythere costata* (Olteanu), *Amnicythere multituberculata* (Livental), *Amnicythere* sp. D (Miculan in Bassetti et al.), *Amnicythere* sp. 2 Gliozzi and Grossi, *Amnicythere* sp., *Euxinocythere (Maeotocythere) praebaquana* (Livental in Agalarova et al.), Mediocytherideini indet., *Pontoniella pontica* (Agalarova), *Camptocypria* sp. 1 Gliozzi and Grossi, *Caspiocypris* sp., *Zalanyiella venusta* (Zalanyi), *Tyrrhenocythere* sp., *Loxoconcha rhombovalis* Pokorny, *Loxoconcha eichwaldi* Livental, *Loxoconcha* sp. A (Miculan in Bassetti et al.), *Loxocorniculina djafarovi* (Schneider in Suzin). On a trouvé aussi dans les échantillons analysés des foraminifères planctoniques remaniés et des gyrogonites de Characeae bien conservés. Les associations d'ostracodes trouvées dans la Plaine de Messarà appartiennent à la Zone à *Loxocorniculina djafarovi* (sensu Carbonnel, 1978), qui caractérise les dépôts du Messinien supérieur dans tout le bassin méditerranéen. A cette période, le faciès bien connu du Lago Mare existait aussi dans l'Île de Crète. La présence des ostracodes paratéthysiens dans les dépôts post-évaporitiques du Messinien, à Faneromeni et à Ano Akria, suggère que des conditions de sédimentation sous-aquatique en milieu saumâtre se sont développées en Crète pendant le Messinien supérieur.

Keywords: Stratigraphy; Palaeogeography; Late Messinian Lago-Mare event; Ostracods; Crete Island

Mots clés : Stratigraphie ; Paléogéographie ; Lago Mare ; Messinien supérieur ; Ostracodes ; Ile de Crète

1. Introduction

During the Messinian, several sedimentary events occurred in the Mediterranean Basin. One of the best-known of them is the so-called Messinian salinity crisis that led to the deposition of evaporites, as massive salt and gypsum beds (Lower Evaporites), in the whole Mediterranean Basin (Hsü et al., 1977). Above these mainly primary evaporites, re-sedimented gypsum-bearing deposits as gypsum-arenites and gypsum-rudites with subordinate primary gypsum deposits (Upper Evaporites) mark the beginning of the post-evaporitic Messinian stage. In Sicily, the Upper Evaporites are interbedded with clays and silts bearing hyperhaline ostracod assemblages (Bonaduce and Sgarrella, 1999). In several places of the Mediterranean Basin, fine- and coarse-grained deposits containing oligo-mesohaline ostracods and molluscs characterizes the post-evaporitic stage of the Messinian (Decima and Wezel, 1973; Carbonnel, 1978; Cita et al., 1980, 1990; Bossio et al., 1981, 1996; Benson and El-Bied-Rakic, 1991; Sarti and Testa, 1994; Roep and van Harten, 1979; Bonaduce and Sgarrella, 1999; Cipollari et al., 1999; Gliozzi et al., 2002; Roveri et al., 2001; Bassetti et al., 2003; Fregni et al., 2003).

In the whole Mediterranean Basin, the stratigraphy of this Messinian post-evaporitic time interval is characterized by the presence of the well-known Lago-Mare biofacies with Paratethyan immigrants. During the late Messinian Lago-Mare event, Paratethyan immigrants, typical of an oligo-mesohaline environment, were widespread in all the palaeo-Mediterranean domain, from Spain to Cyprus (Grekoff and Molinari, 1963; Gramann, 1969; Molinari Paganelli, 1977; Benson, 1976, 1978; Roep and van Harten, 1979; Cita et al., 1990; Borsetti et al., 1990; Robertson et al., 1990; Krstić and Stancheva, 1990; Bossio et al., 1996; Shipboard Scientific Party, 1996; Blanc-Valleron et al., 1998; Bonaduce and Sgarrella, 1999; Cipollari et al., 1999; Gliozzi, 1999; Iaccarino and Bossio, 1999; Rouchy et al., 2001; Gliozzi et al., 2002) owing to the co-occurrence of geodynamical and climatic factors, which temporarily changed the salinity of the palaeo-Mediterranean water body.

In the palaeo-Mediterranean Basin, the Messinian post-evaporitic stage was characterized by more humid climatic conditions with increasing runoff that led to the dilution of the palaeo-Mediterranean hyperhaline waters (McCullogh and De Deckker, 1989). As a consequence, the ecological barrier that during the Middle-Late Miocene was separating the Paratethyan and the palaeo-Mediterranean bioprovinces broke down. The connection between the Paratethyan and the palaeo-Mediterranean brackish-water bodies allows the Paratethyan fauna to migrate into the palaeo-Mediterranean Basin. During the latest Messinian, isolated brackish water-bodies with Paratethyan immigrants were widespread in the whole palaeo-Mediterranean Basin.

However, notwithstanding the Upper Messinian evaporites crop out in several places of the Crete Neogene basins (Meulenkamp et al., 1977, 1979; Delrieu et al., 1993) no data in the literature point to the occurrence on the Crete Island of the late Messinian Lago-Mare biofacies.

Recently, Messinian post-evaporitic deposits bearing oligo-mesohaline ostracod associations with Paratethyan affinity have been found in different places of the Messarà Plain (central Crete, Fig. 1). This paper deals both with the preliminary report on the occurrence of the late Messinian Lago-Mare biofacies on the Crete Island and with the preliminary palaeoenvironmental reconstructions as they result from the palaeoecological indications given by the ostracod assemblages collected in the study sections.

2. The Messinian post-evaporitic facies in Crete

At present, the occurrence in Crete of the latest Messinian post evaporitic deposits is poorly known and a matter of debate. According to several authors the well-known late Messinian Lago-Mare facies does not occur in Crete. Welter-Schultes (2000), Dermitzakis and Marcoloulou-Diacantoni (1979) and