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On the paleogeographic distribution of the Late Maastrichtian planktonic foraminiferal genus Kassabiana SALAJ & SOLAKIUS, 1984

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Abstract

Representatives of the planktonic foraminiferal genus Kassabiana SALAJ & SOLAKIUS, 1984, are recorded in the uppermost Maastrichtian beds from the Parnassus-Ghiona and Pindus Zones, Greece.

The new records have extended the known paleogeographic distribution of the species of Kassabiana in south Tethys northwards to the 30• N paleolatitude. The distribution was restricted to tropical waters since all the records of the species of Kassabiana are from areas which were situated at low latitudes during the Maastrichtian.

Key words: Plankonic Foraminifera, Globotruncanidae, Kassabiana, Upper Cretaceous, Maastrichtian, Paleogeoraphy, Greece.

Resumen

En los estratos del Maastrichtiense superior de Parnassus-Ghiona y Pindus en grecia, se han encontrado formaniníferos planctónicos del género Kassabiana SALAJ & SOLAKIUS, 1984. Estos nuevos hallazgos han ampliado el conocimiento sobre la distribución paleogeográfica de las especies de Kassabiana en paleolatitudes correspondientes a 30• N del Tethys. La distribución de especies de Kassabiana estaba restringida a aguas tropicales ya que todas las especies de Kassabiana son de areas que se situaban a bajas latitudes durante el Maestrichtiense.

Palabras clave: Foraminíferos planctónicos, Globotruncanidae, Kassabiana, Cretácico superior, Maastrichtiense, Paleogeografía, Grecia.

INTRODUCTION

The members of the planktonic foraminiferal genus Kassabiana SALAJ & SOLAKIUS, 1984, Kassabiana falsocalcarata (KERDANY & ABEDELSALAM), Kassabiana falsocalcarata trigonocamerata, SALAJ & SOLAKIUS and Kassabiana bangi SOLAKIUS & SALAJ, are of biostratigraphic importance in the Maastrichtian (Kassab, 1975a; Solakius, 1981, 1983a; Solakius et al., 1984) since they are found to be restricted to the uppermost zone of the Maastrichitian, the Kassabiana falsocalcarata Zone. This zone, which is defined on the total range of the type of the genus, Kassabiana falsocalcarata (KERDANY & ABDELSALAM), was originally estalished by Kassab (1975a) in the uppermost Maastichtian beds of Iraq, and has subsequently been distinguished by Solakius (1981, 1983b) at an equivalent level in the Maastrichtian of NE Tunisia. Salaj (1980) introduced the level of Kassabiana falsocalcarata in the Upper Maastrichtian of El Kef, Tunisia, (a complete sequence of the Maastrichtian and Paleocene, Salaj, 1986; Keller, 1988) thus demonstrating the presence of this species in W Tunisia.

Since the members of Kassabiana were reported solely from the uppermost Maastrichtian beds of Egypt (Kerdany & Abdelsalam, 1969), Pakistan (Doreen, 1974), Iraq (Kassab, 1975a; 1975b) and Tunisia

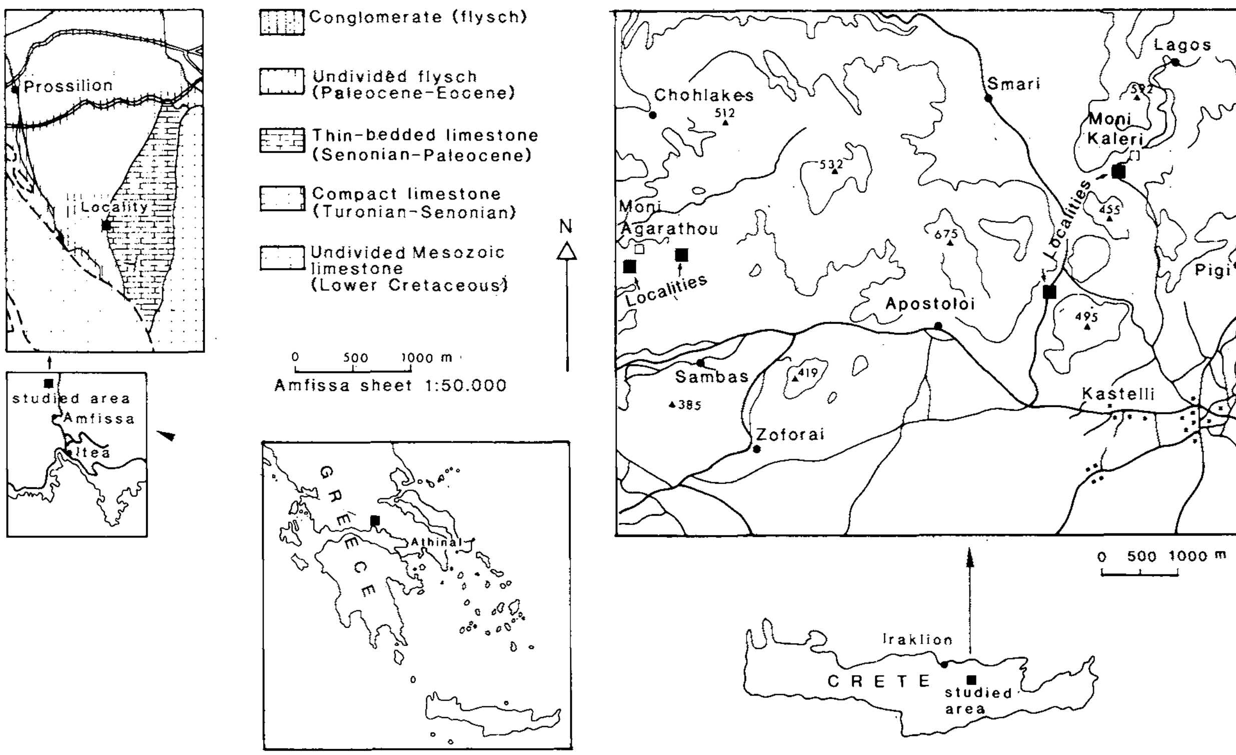

Figure 1.- Geological and topographic maps showing the location of the sections at Prossilion and Crete respectively.

Figura 1.- Mapas geológico y topográfico que muestran la localización de las secciones de Prossilon y Creta respectivamente.

(Salaj, 1980; Solakius, 1983a), it was presumed that their geographic distribution was restricted to these areas. However, during the study of the limestone/flysch boundary (Maastrichtian-Paleocene) at Prossilion in the Parnssus-Ghiona Zone, Central Greece and the Maastrichtian beds at the Kastelli Valley in the Pindus Zone, Crete, South Greece, species of the genus Kassabiana were reported in the uppermost Maastrichtian beds of the sections. The new reconds from Greece suggest that during the Late Mastrichtian the genus Kassabiana in south Tethys must have been far more widely distributed than hitherto has been documented.

THE PARNASSUS-GHIONA ZONE

The Prossilion section

The limestone/flysch boundary section in which the species of Kassabiana were found is exposed at Prossilion, 10 km north of Amfissa in Central Greece (Fig. 1). The section belongs to the Parnassus-Ghiona Zone which is one of the many stratigraphic-tectonic units that make up the Greek mainland and islans. The lower part of the section (Fig. 2) comprises the Maastrichtian limestones, which is compact, thin-bedded foraminiferal packstone, white-brown in color and reddish in some parts. The limestone in strongly bioturbated. The top of the limestone, which early became lithified because the non-deposition that followed, is bored and impregnated with iron oxides. This bed and the mineralized crust of calcium phosphatic-glauconitic composition that overlies the packstone represent a hardground horizon in the sense of Bromley (1975). These crusts which are of stromatolitic type, pass upwards into red calcareous shales rich in foramninifera and in spherical to ellipsoidal bodies, probably reproductive organs of plants.

The crust and the shales are determined as belonging to the Paleocenesince Morozovella pseudobulloides (PLUMMER) and Planorotalites pseudomenardii (BOLLI) are found these beds (Fig. 2).

In the Maastrichtian limestone on the other hand, apart from the Kassabiana species, Kassabiana falsocalcarata (KERDANY & ABDELSALAM) and Kassabiana falsocalcarata trigonocamerata SALAJ & SOLAKIUS (Fig. 2) the following planktonic fo-

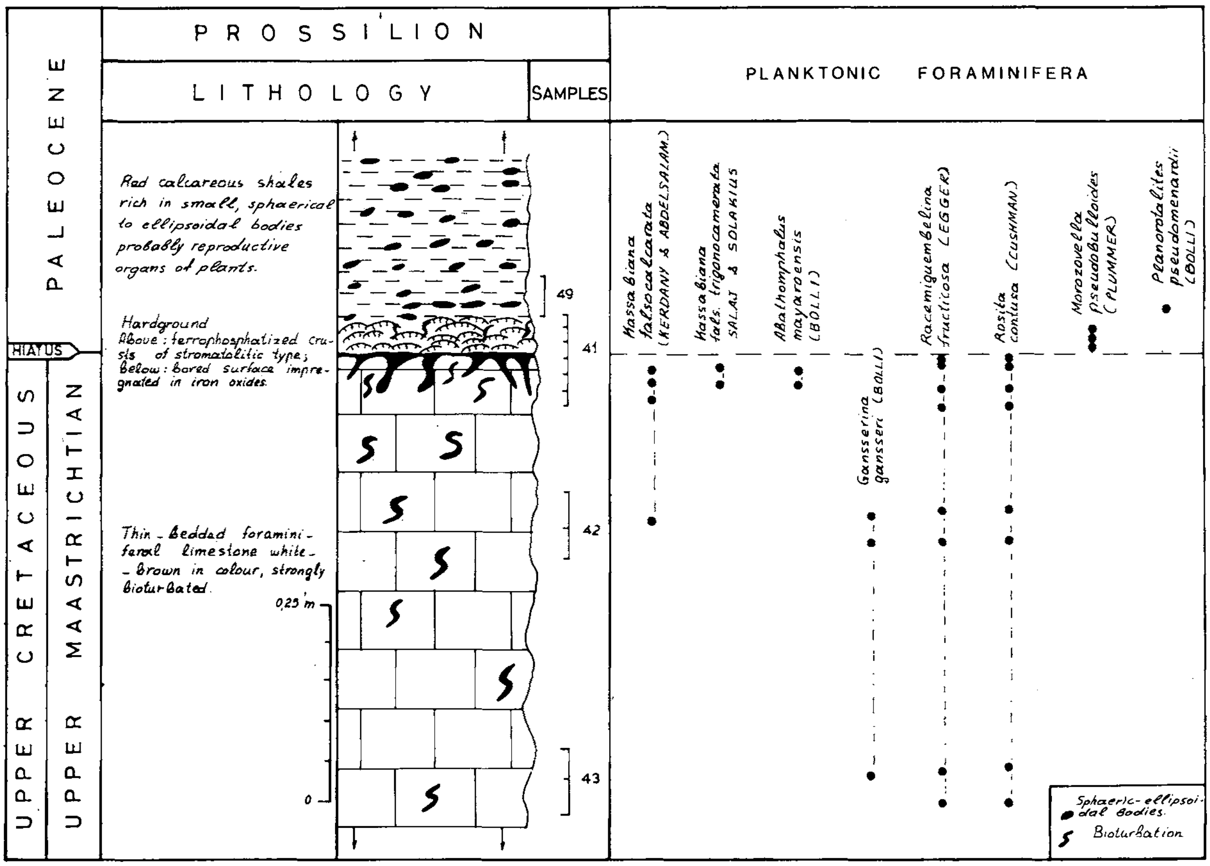

Figure 2.- Diagram showing the lithology and the distribution of the members of Kassaiana and other important planktonic foraminiferal species in the Prossilion section.

Figura 2.- Litología y distribución de los miembros con Kassabiana y otros importantes foraminíferos plantónicos en la sección de Prossilon.

raminiferal species were also determined: Abathomphalus mayaroensis (BOLLI) which is an important zone-marker of the Upper Maastrichtian marking the Abathomphalus mayaroensis Zone established by Bolli (1975), Rosita crusta (CUSHMAN), Globotruncana stuartoconia SOLAKIUS & SALAJ, Globotruncana stuarti (DE LAPPARENT), Globotruncana falsostuarti SIGAL, Plummerita ex gr. hantkeninoides BRONNIMAN, Globotruncanella havanensis (VOORWJIK), Pseudotextularia elegans (RZEHAK), Racemiguembelina fructicosa (EGGER), Racemiguembelina powelli SMITH & PESAGNO, Rugoglobigerina rugosa (PLUMMER), Gansserina gansseri (BOLLI) another important index species in the Maastrichtian marking the Gransserina gansseri Zone in the sense of Bolli (1975), specimens of the group of G. gansseri-Gansserina wiedenmayeri (GANDOLFI) and Racemiguembelina? intermedia (DE KLASZ).

THE PINDUS ZONE

The Kastelli - M. Agarathou sections

The Maastrichtian beds of the Pindus Zone, from which species of Kassabiana were reported, are exposed in an area situated between the Kastelli Valley and the Agarathou Monastery on the island of Crete, South Greece.

The Pindus Zone, which also is an stratigraphic tectonic unit, is represented on Crete mainly by sediments deposited in the external slope on the Pindus trough (transitional facies between the pelagic series of Pindus and the neritic Tripolitza series) which are known as the «Ethia series» (Renz, 1940; Paraskevaidis, 1957) and the «Mangassa series» (Bonneau & Zambetakis, 1975). In this series which are composed of limestone beds followed by the flysch deposits, the deposition of the flisch has started in the Lower Lutetian

(Aubouin & Dercourt, 1965) and the Upper Lutetian (Bonneau & Zambetakis, 1975; Zambetakis-Lekkas, 1977) respectively. In the continental Greece on the other hand the oldest flysch deposits of the Pindus Zone are of Maastrichtian age (Aubouin, 1959; Fleury, 1980).

The Maastrichtian beds with kassabiana, are part of the transitional units between the Pindus and Tripolitza series and are strongly tectonized. They are characterized by the presence of clastic sediments (marls, sandstones, and shales) found within limestone beds of Tertiary age. These clastic sediments may represent flysch deposits, thus indicating the end of the carbonate sedimentation in this part of the basin. On the other hand their presence within the Tertiary limestones, the deposition on which in some areas coninued to the Late Eocene, may be a sign that the flysch sedimentation took place in the inner parts of the basin. The sections with Kassabiana are as follows.

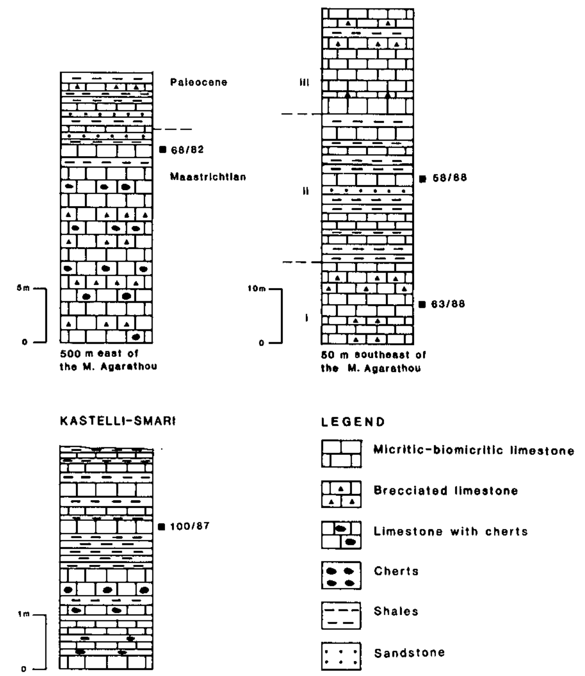

Figure 3.- The sections of the Pindus Zone at Crete examined.

Figura 3.- Secciones estudiadas de las zonas de Pindus y Creta.

The Kastelli-Smari sections

(a) About 3,5 Km north of the Kastelli Valley close to the old Kaleri Monastery on Crete (Fig. 1), in the strongly tectonized area, limestone beds grey in colour alternating with white-yellowish limestone beds with small argillaceous horizons appears (Fig. 3). They pass into an alteration of marls and shales without representing a true flysch.

In the beds were distinguished, Kassabiana falsocalcarata (KERDANY & ABDELSALAM), Rosita contusa (CUSHMAN), Racemiguembelina fruticosa (EGGER), Racemiguembelina? intermedia, (DE KLASZ), Rugogloigerina sp., Plummerita sp., and Globotruncanita gr. stuarti (DE LAPPARENT).

The sequence is in tectonic contact with limestone beds from the Middle Paleocene.

Middle Paleocene.

(b) Close to the crossroads Kastelli-Smari and Kastelli-Apostolloi (Fig. 1), limestone beds alternating with argillaceous shales occur (Fig. 3) in which the following foraminifera association is found:

Pseudotextularia elegans (RZEHAK), Kassabiana falsocalcarata (KERDANY & ABDELSALAM), Globotruncana falsostuarti (SIGAL) and Racemiguembelina fruticosa (EGGER).

The Moni Agarathou sections

(a) 500 m east of the Agarathou Monastery (Fig. 1) micritic and brecciates limestone beds with nodules or siliceous beds occur which develop upwards into shales alternating with sandstones and thin-bedded limestone (Fig. 3). In the lower part of the sequence a Maastrichtian foraminiferal association composed of Kassabiana falsocalcarata (KERDANY & ABDESALAM), Rosita contusa (CUSHMAN), Abathomphalus mayaroensis (BOLLI), Gansserina gansseri (BOLLI), Globoruncanita stuarti (DE LAPPARENT), Raceminguembelina fruticosa (EGGER), Pseudotextularia elegans (RZEHAK), Pseudotetularia deformis KIKOINE, and rugoglobigerina sp., is found while in the upper part species from the Paleocene were destinguished. The sequence is interrupted upwards by faults.

(b) Close to the Agarathou Monastery (50 m) (Fig. 1), a sequence appears composed of (Fig. 3):

(I) thin-bedded micritic limestone alternated with brecciated limestones beds. In these are distinguished Kassabiana falsocalcarata (KERDANY & ABDELSALAM), Globotruncata stuarti (DE LAPPARENT), Grasserina gansesri (BOLLI) and Hetrohelix sp.

(II) shales and marly limestone beds alternating with sandstone and biomicritic limestone beds (Fig. 3) with Kassabiana falsocalcarata (KERDANY & ABDELSALAM), Abathomphalus mayaroensis (BOLLI),

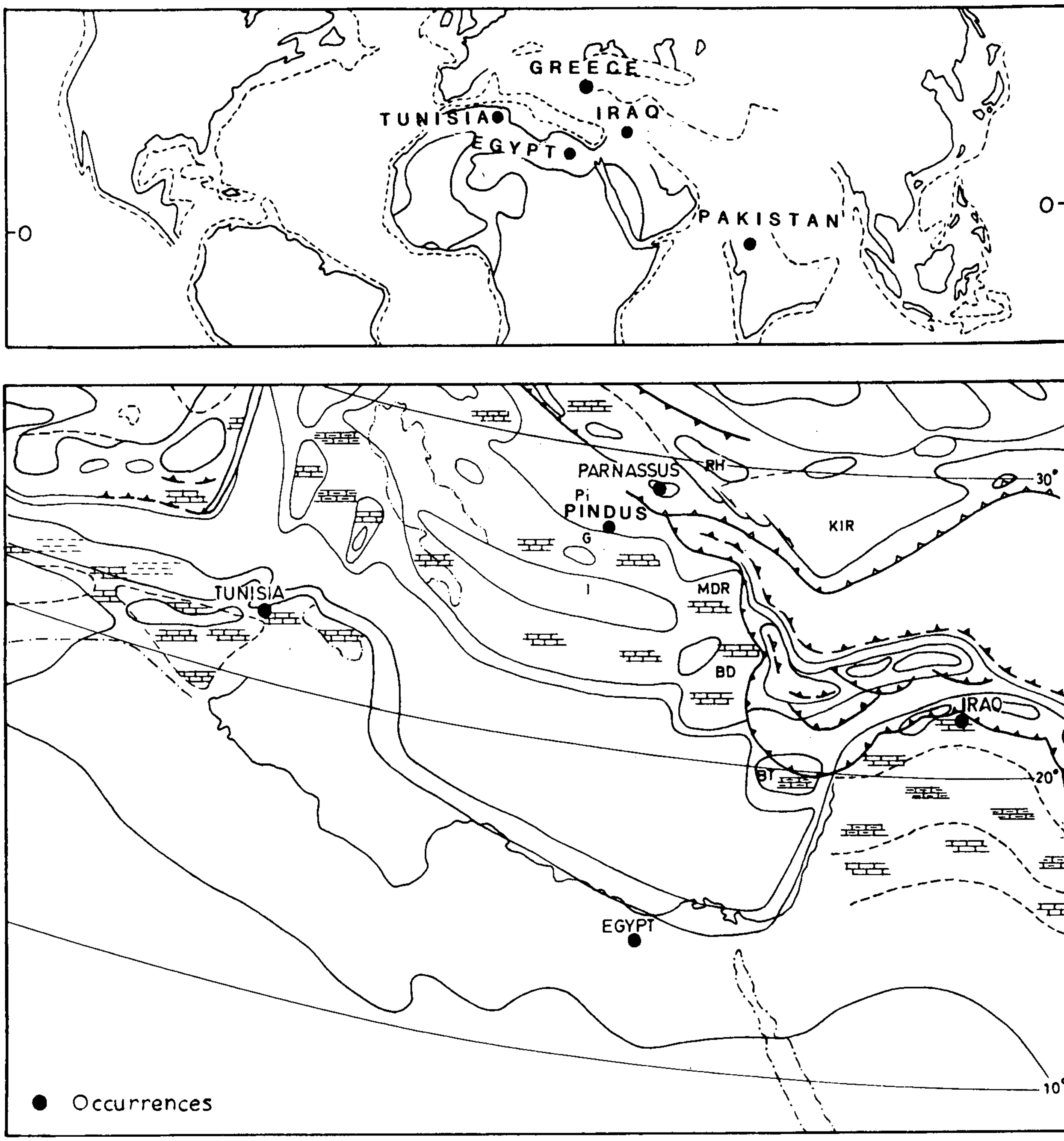

Figure 4.- Paleogeographic maps showing the location of the areas in which the species of Kassabiana were distributed in the Late Maastrichtian. Above, map after Fleury et al., (1985) simplified. Below, simplified map showing part of south Tethys (after Dercourt et al., 1985); note the location of the Parnassus and pindus Zones close to 30•n paleolatitude. RH: Rhodope, KIR: Kirsehir, Pi: Pindus, MDR: Menderes, BT: Basement of Troodos, G: Gavrovo, I: Ionian furrow.

Figura 4.- Mapas palegeográficos que muestran la localización de las áreas con especies de Kassabiana durante el Maastrichtiense. Parte superior, mapa de Fleury et al. (1985) simplificado. Parte inferior, mapa simplificado mostrando parte del sur del Thetys (Dercourt et al., 1985); observar la localización de las zonas de Parnassus y Pindus por debajo de los 30•N paleolatitud. RH: Rhodope, KIR: Kirsehir, Pi: Pindus, MDR: Menderes, BT: Basamento de Troodos, G: Gavrovo, I: surco de Ionian.

Globotruncanella havanensis (VOORWIJK), Rosita contusa (CUSHMAN), Gansserina gansseri (BOLLI) and other Upper Maastrichtian species.

(III) limestone beds often brecciated, alternate with grey or white-yellow thin-bedded limestones and yellow shales (Fig. 3). This Upper Cretaceous sequence is in tectonic contact with the Upper Eocene limestone beds and flysch deposits.

The distribution of Kassabiana

In their discussion on the distribution of the mid-Cretaceous planktonic foraminifers in the shelf sea, Hart & Bailey (1979) presented a fourfold subdivision of the water column (1-4 depth zones) where the small, spinose species of Hedbergella and Whiteinella occupied surface waters (1st and 2nd depth zones) while those of Praeglobotruncana, Rotalipora, Dicarinella and Globotruncana preferred lower depth zones (3rd and 4th depth zones). They suggested evolutionary lineages where the evolved species remained either within the same depth zone or migrated downwards to a low depth zone in order to exploit deeper waters. According to their depth model (which is bases on Be's, 1977, results on the distribution of Recent Planktonic Foraminifera in the Oceans) the globulose morphotypes (members of the 1st dept zone) evolved into flattened morphotypes that would be distributed in the 1st and 2nd depth zones. These have then evolved into keeled biconvex morphotypes (2nd and 3rd depth zones) which in their turn evolved into keeled strongly spiroconvex or planoconvex deep-water morphotypes (3rd and 4rh depth zones).

Using Hart & Bailey's (1979) results, Solakius & Salaj (1986) suggested that in having keeled planoconvex tests the representatives of kassabiana may have migrated after their evolution from Plummaerita, into 3rd (spinose forms) and 4rt (forms without spines) depth zones of water column. However, according to Salaj (1985), the water depth of the eastern Tunisian platform in the uppermost Maastrichtian of which a rich Kassabiana fauna was described (Solakius, 1983a; Salaj & Solakius, 1984; Solakius & Salaj, 1986) was relatively shallow. Salaj (1985) based his opinion on the fact that in the sediments of the section of Dj. Fguira Salah near El Fachs, eastern Tunisia, were found together with the deep-water morphotypes Dicarinella concavata (BRONIZEN) and Dicarinella asymetrica (SIGAL) abundant echinids, redists and a rich benthic formaniniferal fauna. These beds must have been deposited under pelagic conditions on a sea floor which was under elevation. Such relatively shallow but pelagic conditions existed in most parts of the eastern Tunisian paltform (Salaj, 1985).

The view that the Kassabiana species in Tunisia were distributed in shallow enviroments although they have the keeled planoconvex tests which is a characteristic for the deep-water, can be confirmed by the Prossilion record. The specimens of Kassabiana are found at the top Campanian-Maastrichtian limestone sequence which was deposited under pelagic conditions at moderated depths at the begining of the Maastrichtian but the sea became shallower at the end of the Maastrichtian. In the uppermost Maastrichtian sediments apart of the rich planktonic and benthic foraminiferal fauna, also fragments of echinids and brachipods were found. These, together with the stromatolites of type SH followed by types LLH and SS which are regated as having been developed in a shallow marine enviroment (Kalpakis, 1979), speaks for a shallowing of the sea. Note, however, that the water depth in the Parnassus-Ghiona Zone varied considerably during the Maastrichtian since parts of the platform became uplifted (Richter & Mariolakos, 1974). In the shallow water areas, deposition ceased, giving rise to the development of hard-ground, while in deeper parts the deposition has continued uninterrupted.

Kassabiana has also been recorded in deep water sediment as has been show by Doreen (1974) and Kassab (1975). The western Gaj River section, Pakistan, in the uppermost Maastrichtian beds of which Kassabiana falsocalcarata was recorded, consists of deep-water shales, the Tanjero Formation (of Camparian-Maastichtian age), however, from northern Iraq, in the Upper Maastrichtian strata from which Kassab (1975b) described a rich fauna, comprises deep-water deposits (silty marls and limestones) with shallow-water sediments in different horitzons. The

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Plate 1

Lámina 1

Fig. 1-3.- Kassabiana falsocalcarata (KERDANY & ABDELSALAM)

Fig. 1, 145x, Fig. 2, 142x, Sample 41, Prossilion

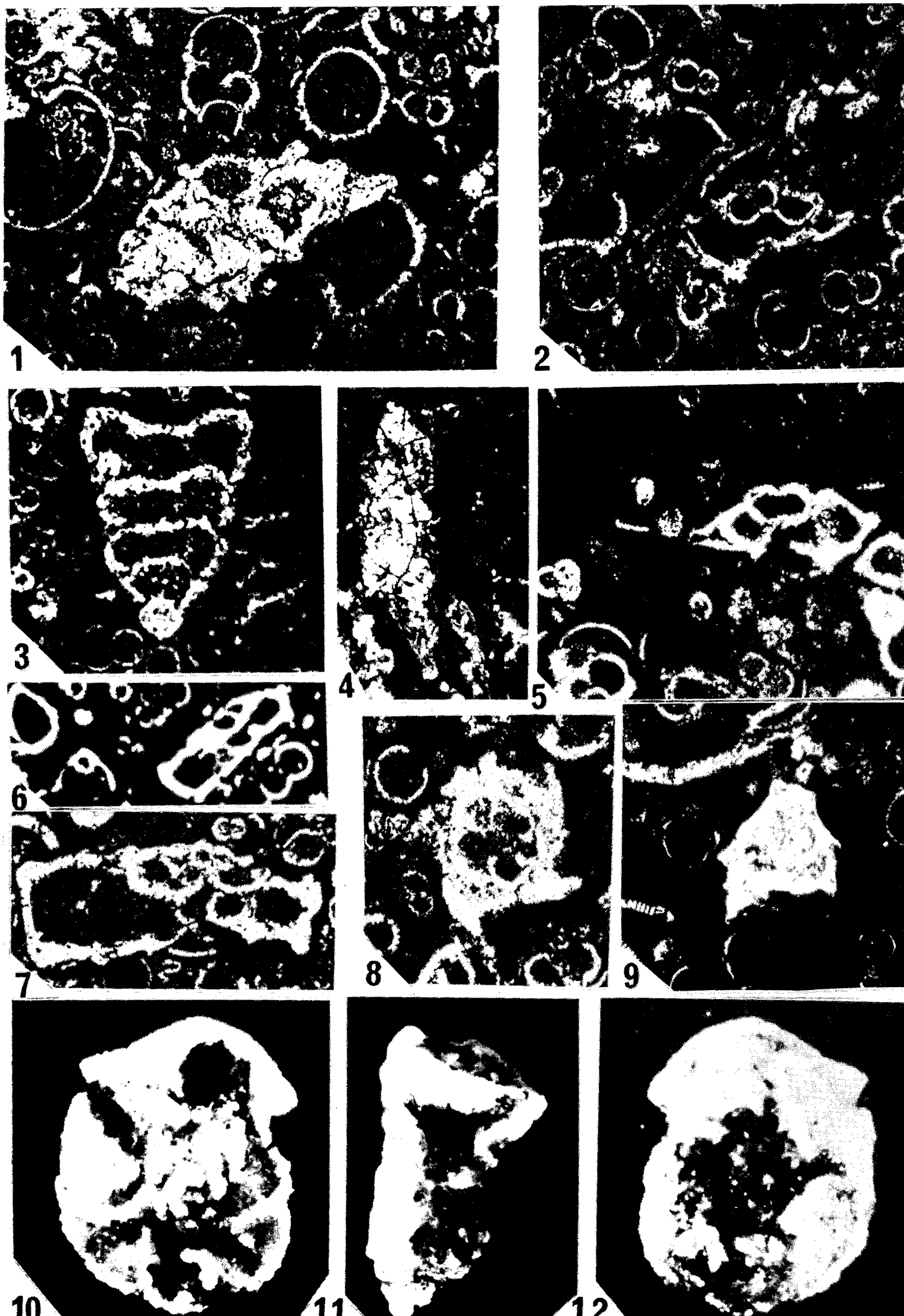
Fig. 3, 140x, sample 68/88, Crete.

Figs. 4, 8.- Juvenile specimen of Kassabiana
Sample 41, Prossilion. Fig. 4, 135x, Fig. 8, 250x.

Figs. 5-6.- Abathomphalus mayaroensis (BOLLI)
Sample 41, Prossilion. Fig. 5, 109x, Fig. 6, 106x.

Fig. 7.- Plummerita ex gr. hantkeninoides BRÖNNIMANN
Note the presence of inflated, elongated chambers in the last whorl. Sample 41, Prossilion. 110x.

Figs. 9-11.- Kassabiana falsocalcarata (KERDANY & ABDELSALAM)
Paratype, originally illustrated by KERDANY & ABDELSALAM (1969) in pl. 2, Fig. 1. 109x.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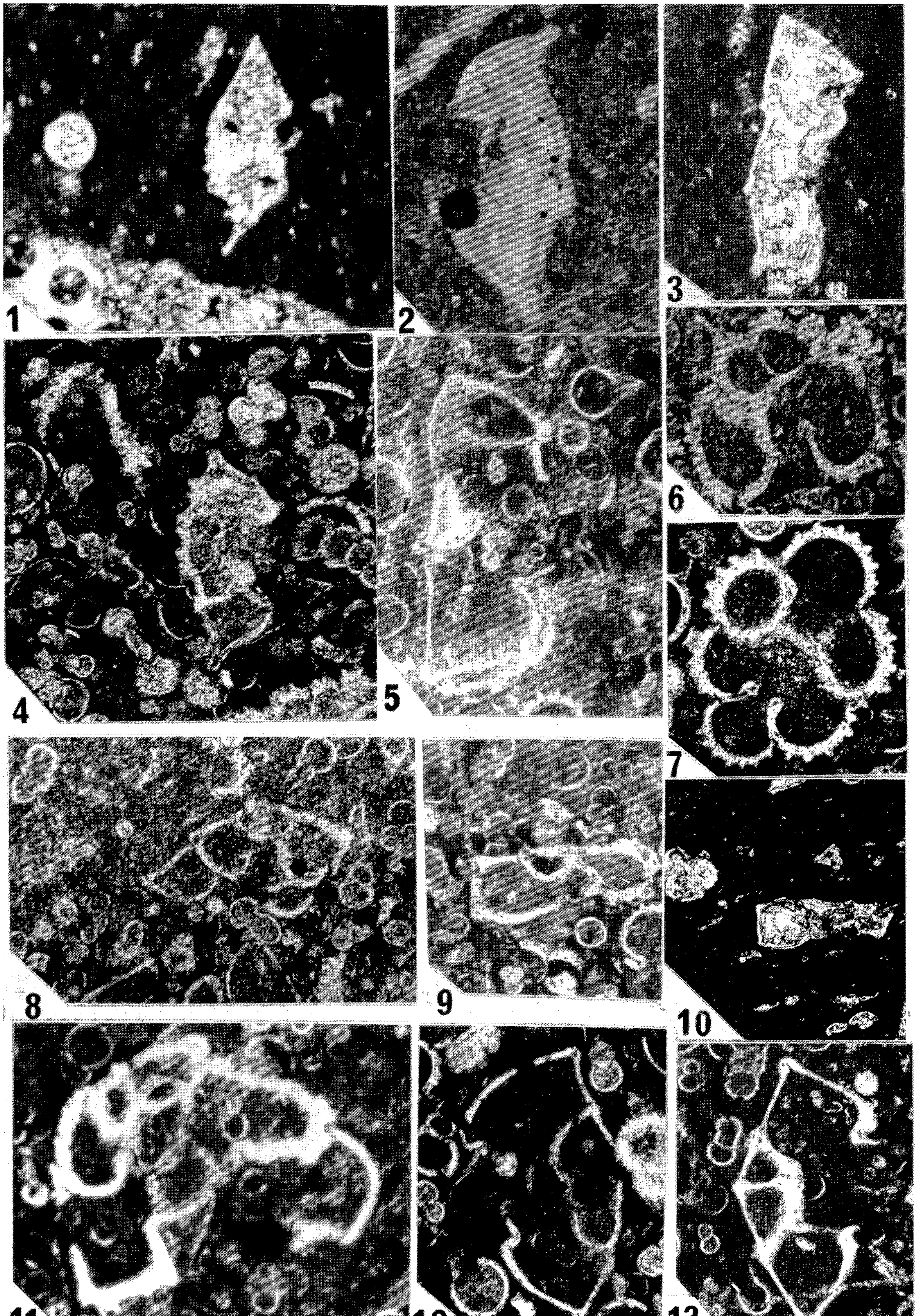
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marine enviroment in the Pindus Zone at Crete is also belived to have been deep. A more detailed study of these sediments is difficult because the sequence at Crete are strongly tectonized.

This evidence on the distribution of Kassabiana species which are found in both shallower and deeper enviroments may indicate that the distribution of the keeled planoconvex especies in the oceas diverged considerably from the distribution of the keeled planoconvex species in the shelf enviroments as presented by Hart & Bailey (1979) in their water depth model.

The above occurences of Kassabiana shows that during the Late Maastrichtian time the geographic distribution of Kassabiana species in south Tethys was much wider than was originally believed. These occurrences also point to the fact that the distribution of theses species were restricted to tropical waters (tropical bioprovince, Scheibnerova, 1972) since during de Maastrichtian the areas in which these species were recorded were situated between 30• N and 20•S paleolatitudes (Fig. 4). It is therefore difficult to explain why these species of Kassabiana were not reported from Upper Maastrichtian sequences examined from south Tethys other than those mentioned above, but misidentification though lack of knowledge of Kassabiana could be one reason since these species have only recently been described. An example of misidentification occurs in the work of Almogi-Labin et al., (1986) of the Santonian Globotruncnids from Israel. The illustration of the specimen named Gansserina gansseri (BOLLI) (pl. 10, Fig. 14) is, in fact, a Kassabiana species. It has the Plummerita-like later stage that are the main characteristics of the genus Kassabiana.

SUMMARY

It has been shown that the presence of the representatives of Kassabiana in the uppermost Maastrichtian of the Parnassus-Ghiona and Pindus Zones indicates that these species were not endemic as previously supposed, but had a wider distribution in south Tethys extending northwards as far as the areas situated close to the 30•N paleolatitude. They are found in Parnassus in beds that were deposited in a shallowing sea similar to the eastern Tunisian platform while the Pindus Zone is of a deeper enviroment.

It is further shown that in order to record Kassabiana species they must be looked for in beds deposited in warm waters, since all the records are from areas which during the Maastrichtian were restricted to the 30•N and 20•S paleolatitudes.

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Plate 2

Lámina 2

Figs. 1-3.- Kassabiana falsocalcarata (KERDANT & ABDELSALAM)

Fig. 1, 105x, FIg. 2, 90x, Sample 58/88, Fig. 3, 94x, Sample, 68/87, Crete.

Fig. 4.- Recemiguembelina powelli SMITH & PESSAGNO
Sample 41, Prossilion, 118x.

Fig. 5.- Probably a Kassabiana species
Sample 43, Prossilion, 100x.

Fig. 6.- Specimen belonging probably to the group of Gansserina gansseri (BOLLI) - Gansserina wiedenmayeri (GANDOLFI). Note the presence of a double keel in the las chamber.
Sample 41, Prossilion, 120x.

Fig. 7.- Racemiguembelina fruticosa (EGGER)
Sample 43, Prossilion 87x.

Fig. 8.- Kassabiana falsocalcarata trigonocamerata SALAJ & SOLSKIUS.
Sample 41, Prossilion, 110x.

Figs. 9, 12.- Abathomphalus mayaroensis (BOLLI)

Fig. 9, 84x, Sample 41, Prossilion; Fig. 12, 90x, Sample 68/87, Crete.

Fig. 10.- Gansserina gansseri (BOLLI)
Sample 42, Prossilion 94x.

Fig. 11.- Rosita contusa (CUSHMAN)
Sample 41, Prossilion, 51x.

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