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CORRELATION BETWEEN THE CONTINENTAL DEPOSITS OF THE LOWER AXIOS VALLEY AND PTOLEMAIS BASIN*

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ABSTRACT

The stratigraphy of the Neogene-Quaternary continental deposits of the lower Axios valley and Ptolemais basin is studied and their possible correlation is discussed. A synoptic stratigraphic column with the lithostratigraphic units, as well as all the known and some new palaeontological data are given for each area. Then the two columnes are compared and it is tried to be correlated.

ΣΥΝΟΨΗ

Στην εργασία αυτή εξετάζεται η στρωματογραφία των Νεογενών-Τεταρτογενών ηπειρωτικών αποθέσεων του κατώτερου τμήματος της κοιλάδας του Αξιού ποταμού και της ευρύτερης λεκάνης της Πτολεμαΐδας και γίνεται μια προσπάθεια συσχέτισης τους. Δίνονται οι συνοπτικές στρωματογραφικές στήλες για κάθε περιοχή, καθώς επίσης και όλα τα μέχρι σήμερα γνωστά παλαιοντολογικά δεδομένα συμπληρωμένα με ορισμένα νέα. Από το συσχετισμό των δύο στηλών προκύπτουν οι ακόλουθες αντιστοιχίες μεταξύ των σχηματισμών της λεκάνης της Πτολεμαΐδας αφ΄ ενός και της κοιλάδας του Αξιού αφ΄ ετέρου: Ο Σχηματισμός Βεγόρας συσχετίζεται πιθανώς μ΄ εκείνον του Δυτικού. Το κατώτερο τμήμα (Μέλος Καρδιάς) του Σχηματισμού Πτολεμαΐδας με το Μέλος Εμβόλου του Σχηματισμού Αγγελοχωρίου (MN-14). Το υπόλοιπο τμήμα του Σχηματισμού Πτολεμαΐδας (ενδιάμεσα στείρα και Μέλος Ανάργυροι) φαίνεται ότι είναι ανάλογο μ΄ εκείνο της Γέφυρας (MN-15? και MN-16). Τέλος μπορούν να συσχετισθούν τα όρια μετάβασης Πλειοκαίνου-Πλειστοκαίνου των δύο κοιλάδων και τα αντίστοιχα κατωπλειστοκαινικά κροκαλοπαγή τους.

1. INTRODUCTION

The Ptolemais basin is part of a large down-faulted basin, which extends from Bitola (Yugoslavia) in the north to Servia (near Kozani) in the

* ΣΥΣΧΕΤΙΣΗ ΤΩΝ ΗΠΕΙΡΩΤΙΚΩΝ ΑΠΟΘΕΣΕΩΝ ΤΗΣ ΚΟΙΛΑΔΑΣ ΤΟΥ ΑΞΙΟΥ ΠΟΤΑΜΟΥ ΚΑΙ ΤΗΣ ΛΕΚΑΝΗΣ ΤΗΣ ΠΤΟΛΕΜΑΪΔΑΣ

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south (NW Macedonia, Greece, fig. 1). The lowest acceptable age of the creation of the original graben is that of middle to late Miocene, according to the oldest known deposits (PAVLIDES 1985). A lot of palaeontological and lithostratigraphical works have been done in the area, because of the economic interest of the lignite deposits (e.g. EHLERS, 1960; ANASTOPOULOS & KOUKOUZAS, 1972; KOUKOUZAS et al., 1979; VELITZELOS & PETRESCU, 1981; IOAKIM, 1981). The present paper contains a summary of all known data in combination with our field observations in order to determine a general stratigraphical column for the entire area.

The stratigraphy of the Neogene continental deposits of the lower Axios valley, Thessaloniki area (Fig. 1) is known well enough (ARAMBOURG & PIVETEAU, 1929; BONIS et al., 1977; KOUFOS, 1980; 1984; BONIS et al., 1985). Many mammal localities found in the area, and the rich fauna which they contain, allowed an exact dating of the majority of the deposits. All these lithostratigraphical and biostratigraphical data are combined in order to

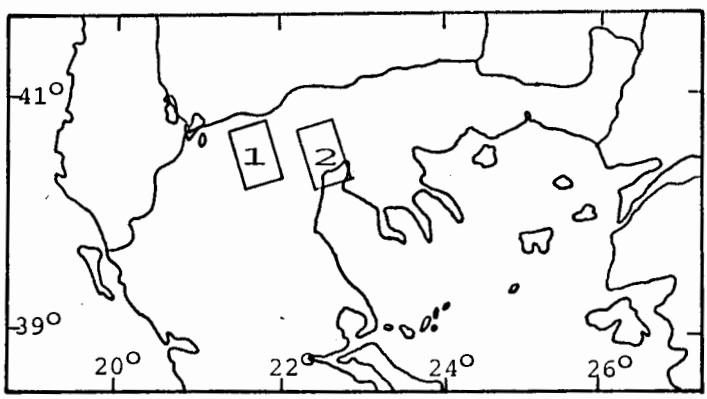

Fig. 1. Geographical position of the studied areas. 1. Ptolemais basin. 2. Axios valley.
Σχ. 1. Γεωγραφική τοποθέτηση των περιοχών έρευνας. 1. Λεκάνη Πτολεμαΐδας. 2. Κοιλάδα Αξιού ποταμού.

give a general stratigraphical column for the continental deposits of the valley.

Finally the columns of the two areas are correlated on the basis of the biostratigraphical data.

2. PTOLEMAIS BASIN

The Neogene and Quaternary sediments which fill up the Ptolemais basin are divided in the following lithostratigraphic units.

1. The lower unnamed formation of basal conglomerates consisting of pebbles taken from basement; mainly from metamorphic rocks. The beds of this

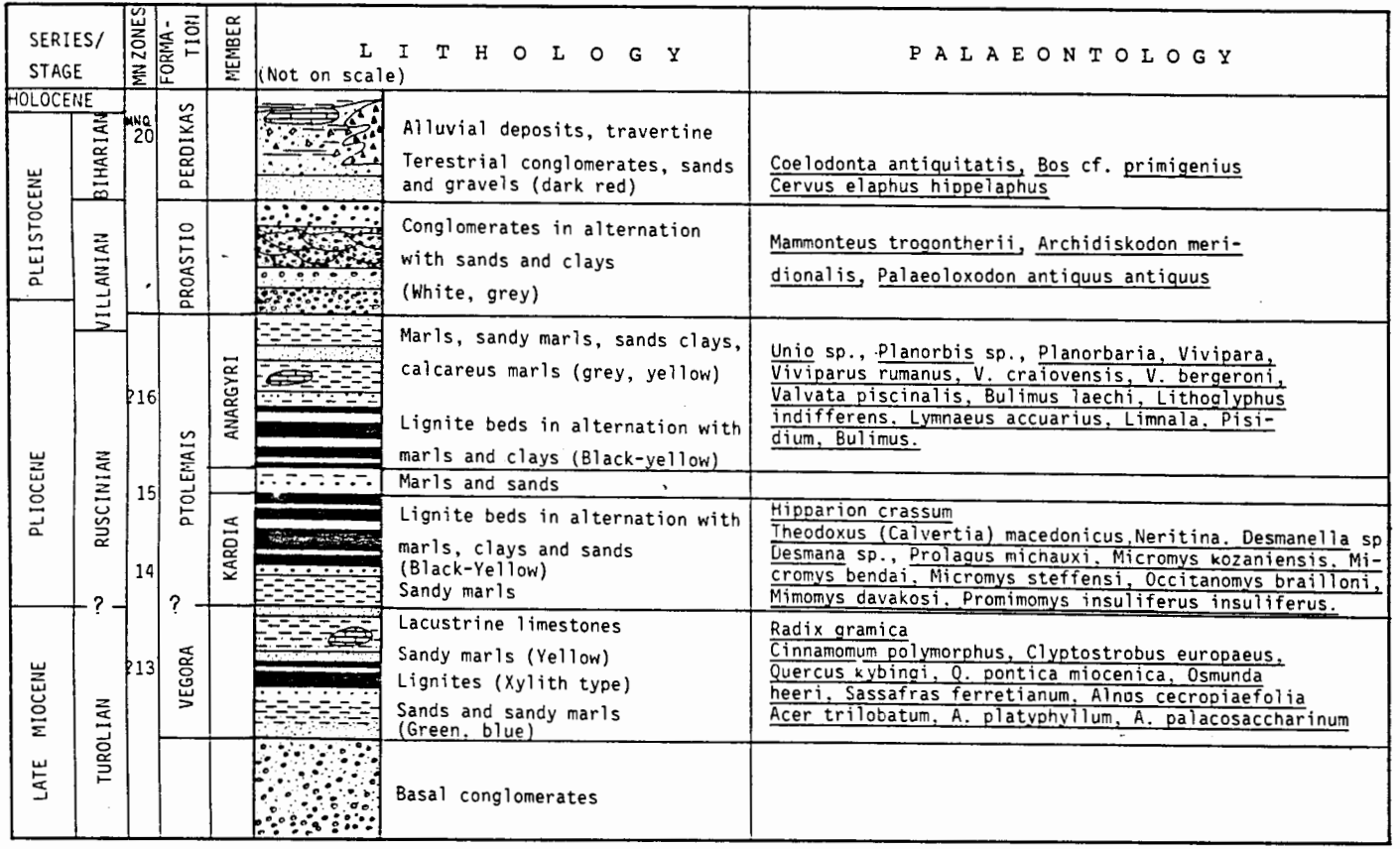

Fig. 2. Stratigraphy of the Ptolemais basin continental deposits; palaeontological data as referred in the text.

Σχ. 2. Στρωματογραφία των ηπειρωτικών αποθέσεων της λεκάνης της Πτολεμαΐδας; τα παλαιοντολογικά δεδομένα συγκεντρώθηκαν από διάφορες εργασίες, που αναφέρονται στο κείμενο.

formation lie unconformably on the Palaeozoic-Mesozoic rocks of Pelagonian zone and pass transitionally into marly layers of the next formation. It is traced in some deep boreholes only.

2. The Vegora Formation of latest Miocene-early Pliocene consists of marls, sandy marls, sands and lignite (xylite type). The yellow marl beds of the formation include some characteristic fossil plant species of Pontian s.l. age (VELITZELOS & PETRESCU, 1981; VELITZELOS & GREGOR,1985). Some layers of the formation have been detected in boreholes in the eastern and central part of the basin (e.g. Anargiri, Komnina?) as early Pliocene after palynological study by Ioakim (1981, 1984).

3. Furthermore follows the Ptolemais Formation transitionally too, which is accepted as of Pliocene age (EHLERS, 1960; ANASTOPOULOS & KOUKOUZAS, 1972; IOAKIM, 1981). It consists from argillaceous layers, marls, sands, lignite bed (know as Ptolemais type) and lacustrine calcareous muds in a alternative sequence. Furthermore, the formation could be divided in two members the Kardia Member and Anargiri Member. The Kardia Member includes the lower lignite bed's group (Kardia and Main Field, ANASTOPOULOS & KOUKOUZAS, 1972) and has a Ruscinian age (MN-14, 15) as indicated by micromammals (WEERD, 1979) and Hipparion crassum (KOUFOS, 1982). The Anargiri Member includes the upper ligniferous beds of Ptolemais Formation (ANASTOPOULOS & KOUKOUZAS, 1972) and covers the late Pliocene (MN-16?). Between of these two members there are some deposits without lignites, which consists of thin marly beds detected in some boreholes only, e.g. South Field, Anargiri. Thus Ptolemais Formation must be considered of Pliocene age.

4. The Quaternary deposits start with the Proastion Formation of Early Pleistocene (late Villafranchian) consisting of fluvioterrestrial conglomerates, sands and gravels (possible zones of MNQ-17, 18, 19). The deposits of this formation extend in the whole basin, but, enough of them lie near the villages of Proastio, Sotir and Petres. They include a vertebrate fauna with Archidiskodon meridionalis, Palaeoloxodon antiquus, Mammonteus tronglotherii, Cervus elephus (MITZOPOULOS, 1964; MARINOS, 1964; FAUGERES, 1966; SOULIOS, 1972; VELITZELOS & SCHNEIDER, 1973). A complete mandible of Archidiskodon cf. meridionalis has been found by us, into the uppermost sand beds of Sotir.

5. The Perdikas Formation consisted of red terrestrial conglomerates and sands, lateral fans and very recent alluvial deposits. From the red conglomerates and sands we collected a mammalian fauna includes the species Coelodonta antiquitatis, Cervus cf. elaphus and Bos cf. primigenius indicating a Middle-Upper Pleistocene age.

All the known data about Ptolemais basin are summarized in figure 2

with the stratigraphical column and the lithostratigraphic units, with their lithology, fauna and age. This column is a general one for the deposits of the wider Ptolemais basin (Ptolemais, lignite field, Komnina valley, Anargiri field, Vegora, Amynteon basin).

3. LOWER AXIOS VALLEY

The Neogene-Quaternary deposits of the lower Axios valley are divided into the following lithostratigraphic units:

1) The Nea Mesimvria Formation, which is the oldest known and consists of very hard red-beds rich in sand and gravels. The fauna found (Fig. 3) dates back the Nea Mesimvria Formation as late Vallesian (MN-10); between 9-11 m.y. to be exact (BONIS et al., 1985).

2) The Vathylakkos Formation consists of light coloured sediments,which are yellowish marls at the base, sands, gravels, sandy marls, sometimes with cross-bedding. It also includes a large number of mammal localities with a very rich fauna (Fig. 3), which is older than the Pikermi one and indicates a late Vallesian-early Turolian age (Mn-11); more precisely betweeen 7-9 m.y. (BONIS et al., 1985).

3) The Dytiko Formation situated in the western bank of the Axios river consists of grey sands and gravels with lignite traces, sometimes with cross--bedding, as well as yellowish sands, sandy marls, marls and limestones in the top. The studied fauna of the Dytiko Formation (Fig. 3) is younger than the Pikermi one and dates back to late Turolian (MN-13); more precisely, between 5,5-7 m.y.(BONIS et al., 1985). A flora of late Miocene-Pliocene age was found in the limestones of the top (MERCIER-SAUVAGE, 1966). Thus the Dytiko formation is rather the transition from Miocene to Pliocene.

4) The Angelochori Formation, which could be divided in two members - a lower one, named Emvolon Member and an upper one, named Gefira Member.The Emvolon Member is situated near the cape of Megalo Emvolon (Karaburun) and consists of reddish marls and grey sandy marls alternated with gravels. The mammalian fauna found (ARAMBOURG-PIVETEAU, 1929; STEFFENS et al., 1979) indicates an early Ruscinian age (MN-14) for the Emvolon Member.

The Gefira Member is situated between the villages of Gefira and Vathylakkos and consists of alternated sands and gravels. The fossils from this formation are very few. The species Anancus arvernensis and Hipparion sp. are found. Anancus arvernensis indicates a younger age for the Gefira Member while Hipparion indicates an age older than Pleistocene. Thus the Gefira Member must be considered of late Ruscinian - early Villanyian (Villafranchian) age (MN-15, 16) and it probably terminates the Pliocene.

SERIES	STAGE	MN ZONES	FORMATION	MEMBER	LITHOLOGY (Not on scale)	PALAEONTOLOGY
PLEISTOCENE					Alluvial deposits Terra rossa	Palaeoloxodon antiquus
PLIOCENE	VILLANYIAN	MN-15	ANGELOCHORI	GEFIRA	Alternated sands and gravels usually grey	Anancus arvernensis Hipparion sp.
	RUSCINIAN	MN-14		EMVOLON	Reddish marls, grey sandy marls alternated with sands and gravels	Hipparion longipes, Sus minor, Parabos macedoniae, Gazella bailloudi, Spalax odessanus, Oryctolagus cf. laynensis.
UPPER MIOCENE	TUROLIAN	MN-13	DYTIKO		Grey sands, gravels and yellowish marls, sands sandy marls and fresh-water limestones	Chasmaporthetes bonisi, Hipparion matthewi, H. periafricanum, Protragelaphus theodori, Palaeoreas lindermayeri, Palaeotragus rouenii, Dorcatherium puyhauberti.
		MN-12				
		MN-11	VATHYLAKKOS		Light coloured alternated sands, gravels sandy marls and marls	Ictitherium robustum, Plesiogulo crassa, H.dietrichi, H. mediterraneum, Nisidorcas planicornis, Dorcatherium puyhauberti, Samotherium boissieri. Adcrocuta eximia, Hipparion primigenium, Nisidorcas planicornis, Helladotherium duvernoyi, Palaeoreas zouavei, Prostrepsiceros (Helicotragus) zitteli, P.(H). rotundicornis.
	VALLESIAN	MN-10	N.MESIMVRIA		Red-beds rich in sands and gravels ?	Progonomys cathalai, Adcrocuta eximia leptoryncha Hipparion primigenium, H. macedonicum, Mesembriacerus melentisi, Decennatherium pachecoi, Ouranopithecus macedoniensis.

Fig. 3. Stratigraphy of the lower Axios valley continental deposits; selected faunistic data from ARAMBOURG & PIVETEAU, 1929;BONIS et al., 1979;KOUFOS, 1980,84; BONIS et al., 1985 and STEFFENS et al., 1979.

Σχ. 2. Στρωματογραφία των ηπειρωτικών αποθέσεων του κατώτερου τμήματος της κοιλάδας του Αξιού ποταμού; τα παλαιοντολογικά δεδομένα προέρχονται από τους ARAMBOURG & PIVETEAU, 1929; BONIS et al., 1979; KOUFOS, 1980, 84; BONIS et al., 1985 και STEFFENS et al., 1979:

5) The Pleistocene deposits are situated unconformably on the Pliocene ones (MARINOS, 1964) and they consist of terra rossa and alluvial deposits. The fossils are very few and thus a biozonation and exact dating is impossible. The only indication comes from the area of Vathylakkos, where Palaeoloxodon antiquus was found in the terra rossa beds (BONIS et al., 1973).

4. CORRELATION

Comparing the lithostratigraphic and biostratigraphic data, derived from the study of both, the lower Axios valley and the Ptolemais basin, a correlation between the Neogene/Quaternary continental deposits of these areas is feasible, which is attemped here.

The Vegora Formation of Ptolemais basin has been dated by its flora to latest Miocene passing to earliest Pliocene. The total formation possibly corresponds to the MN-13 and MN-14 mammal's zone. Unfortunately no mammal fossils have been found to prove it. On the other hand, the Dytiko Formation of the lower Axios valley has been dated by its mammal fauna to late Turolian, while its uppermost limestone layers include a flora indicating a Miocene - Pliocene age. That is an age of late Turolian-beginning of Pliocene (possible MN-13 and 14 zones) for the Dytiko Formation is acceptable. Thus the Vegora Formation could be correlated with the Dytiko one, while their upper layers represent the boundary of Miocene/Pliocene. This boundary is clearer in the lower Axios valley (the uppermost layers of fresh-water limestones of Dassero, Agrosykkia) but it isn't so clear in the Ptolemais basin (the beds of the yellow sandy marl situated in the top of the Vegora Formation is possibly the uppermost layers of the formation). Nevertheless the grey-black sediments of the Ptolemais Formation help to trace the top of the Vegora Formation. These two studied formations are isochronous and indicate the transition from Miocene to Pliocene.

The Kardia Member, which is the lower part of the Ptolemais Formation is dated as early Ruscinian (MN-14) by micrommals. In the uppermost part of the Kardia Member where Hipparion crassum has been found a younger age (MN-15) is indicating. So the Kardia Member must be considered of early-middle Ruscinian. On the other side, in the lower Axios valley the Emvolon Member of the Angelochori Formation has been dated by its mammalian fauna to early Ruscinian (MN-14), but there are no indications about the presence of the zone MN-15 in the Emvolon Member. So, it can be correlated with the lower part of Kardia Member.

The Anargyri Member includes the upper part of the Ptolemais Formation and it has been dated to Late Pliocene by palynological analyses. The part of the Ptolemais Formation which includes the upper beds of the Kardia Mem-

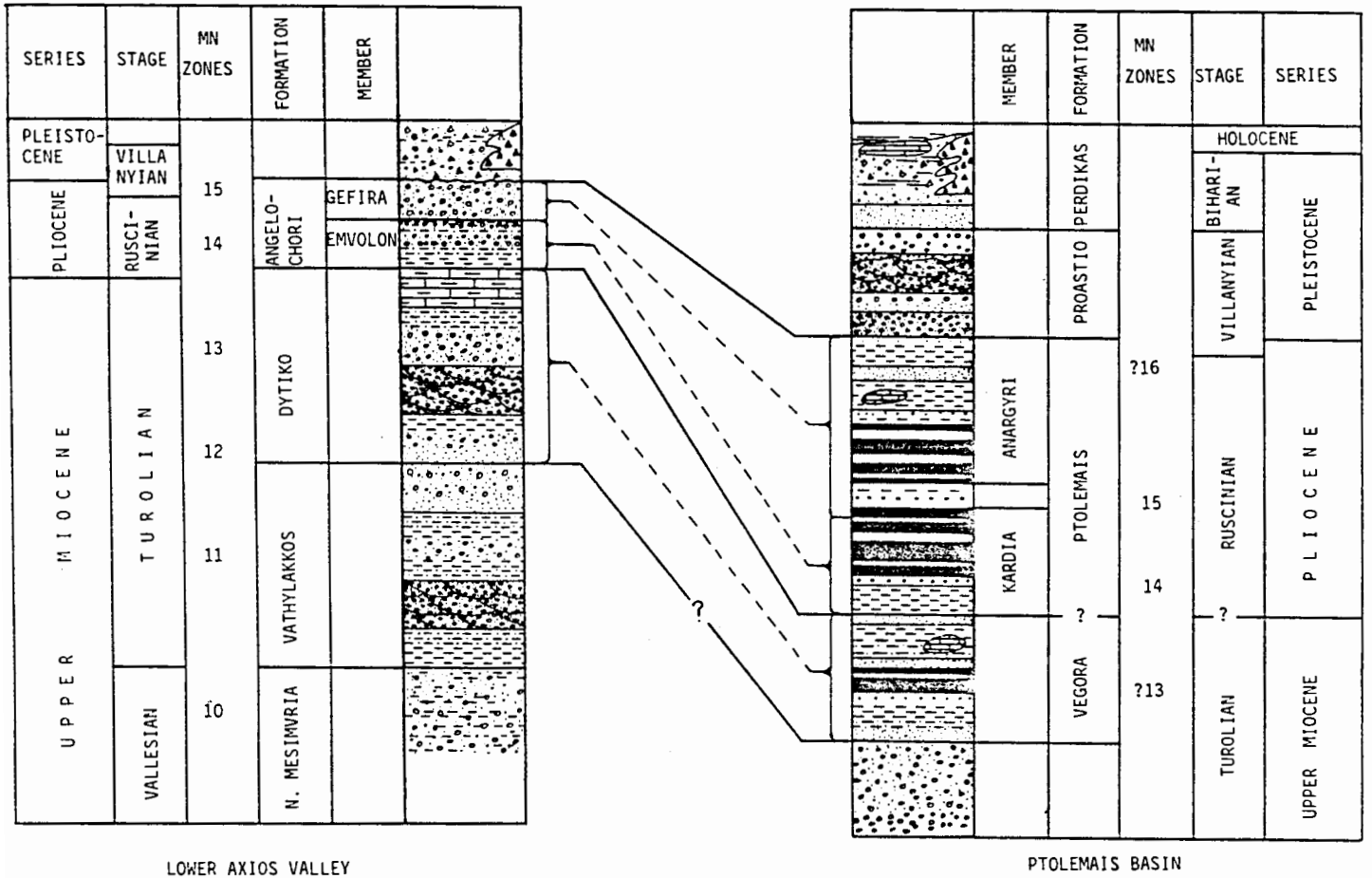

Fig. 4. Biostratigraphical correlation between the Neogene/Quaternary continental deposits of the lower Axios valley and Ptolemais basin.

Σχ. 4. Βιοστρωματογραφικός συσχετισμός μεταξύ των Νεογενών/Τεταρτογενών αποθέσεων της λεκάνης της Πτολεμαΐδας και του κατώτερου τμήματος της κοιλάδας του Αξιού ποταμού.

ber, the intermediate sterile beds and the Anargyri Member possibly belongs to the zones MN-15,16. The zone MN-15 is traced by the presence of Hipparion crassum butno mammals of MN-16 have been found. In the lower Axios valley the Gefira Member of the Angelochori Formation is considered as late Pliocene because of the presence of Hipparion sp. and Anancus arvernensis. The presence of Hipparion indicates an age older than Pleistocene while the mastodont A. arvernensis indicates a late Pliocene one (MN-16). After that the Gefira Member must be considered as late Pliocene (MN-15,16). Thus the Gefira Formation corresponds to the upper part of the Ptolemais Formation (upper beds of the Kardia Member, intermediate sterile beds and Anargyri Member). On the basis of the above mentioned data the Ptolemais Formation can be correlated with the Angelochori Formation of the lower Axios valley. The end of the Pliocene in the Ptolemais basin is defined by the presence of a hard conglomerate (Proastion conglomerates) which is the base of the Pleistocene deposits. In the lower Axios valley the Pleistocene deposits overlie the Pliocene ones unconformably (MARINOS, 1966) and this unconformity is the Pliocene/Pleistocene boundary. These two levels are isochronous and represent the transition from Pliocene to Pleistocene.

The absence of fossils in the Pleistocene deposits of the lower Axios valley does not allow us to distinguish smaller stratigraphical units and make a detailed dating. Thus we can only consider that the Proastion and Perdikkas Formation of the Ptolemais corresponds to the whole Pleistocene deposits of the lower Axios valley. The biostratigraphical correlation between the Neogene/Quaternary deposits of the two studied areas is given in Fig. 4.

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